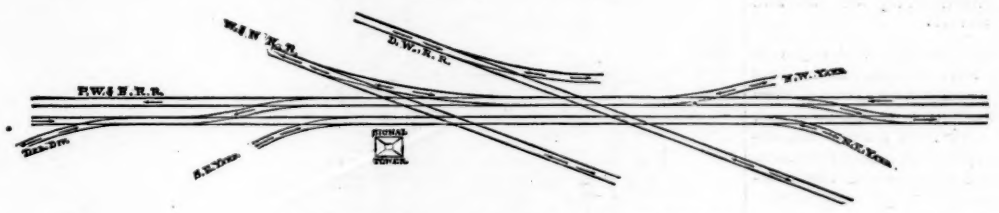
RAILROAD GAZETTE

FRIDAY, FEBRUARY 11, 1881.

Interlocking Apparatus at Union Junction, Del.

The engraving herewith represents a plan of the tracks at Union Junction, in Wilmington, Del., where the Pennsylvania Steel Company has quite recently laid down the interlocking apparatus patented by Mr. A. G. Cummings. It is at this point where the Delaware, the Delaware Western and the Wilmington Northern railroads join the main line of the Philadelphia, Wilmington & Baltimore road. In the summer and autumn the enormous fruit traffic of the Delaware Western, with the business of the other lines, must be transferred to the Philadelphia, Wilmington & Baltimore road at this point. The tracks of these roads have lately been changed, and all their junctions have been concentrated at a point west of the passenger station in Wilmington. This place is now called Union Junction.

The facility and safety which are afforded by a system of interlocking switches and signals at junctions and terminal points has long been recognized in England, but it is only within a few years that it has come into use in this country. As traffic increases the demand for apparatus of this kind at such places becomes more imperative, and it is therefore not surprising that such appliances are rapidly coming into use on some of our lines, and, owing to the importance of the subject, elaborate illustrations and descriptions of various kinds



CROSSING AT UNION JUNCTION, DELAWARE.

of interlocking apparatus have been published in these pages, and will be found in the *Railroad Gazette* of Oct. 16, 1875; Feb. 11, Oct. 13 and 20, Nov. 3, 1876, and July 12, 1878.

The location of the tracks at Union Junction, is, as shown in the plan, somewhat complicated. As will be seen there are two main line tracks of the Philadelphia, Wilmington & Baltimore, a junction with these of the Delaware Railroad, one switch leading to the southeast yard, two switches leading to the northeast and northwest yards respectively, and four cross-over switches, all in the Philadelphia, Wilmington & Baltimore tracks. There is also a crossing track of the Wilmington & Northern road, with two switches forming a junction with the Philadelphia, Wilmington & Baltimore line; a crossing track of the Delaware Western, with one switch forming a junction with the northwest yard of the Philadelphia, Wilmington & Baltimore road. Besides these there are three dead switches to break the tracks of the crossing lines. All the above named switches are provided with safety-point locks and detector bars. In connection with the above switches and locks there are two distant signals, respectively 2,150 ft. and 1,500 ft. from the signal tower, twelve home signals and three yard signals, by which signals the movements of the traffic are controlled. In the signal tower there are thirty hand levers arranged in one frame, 28 being used to operate the switches, locks and signals above mentioned, leaving two spare levers for future improvements.

The Pennsylvania Steel Company, which constructed this apparatus and owns the Cummings patents, has now made the manufacture and erection of interlocking apparatus one of its specialties. This company has for years been one of the largest manufacturers of steel rails, frogs, switches, etc., in the country, and we learn it has made preparations for this new branch of their business on the most extensive scale. Its works are at Steelton, near Harrisburg, Pa., and its office at No. 204 South Fourth street, Philadelphia.

A complete description and illustrations of the apparatus which has been put down at the Union Junction is being prepared for us, and will shortly appear in our columns.

Contributions.

The Groveland Bridge Disaster.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I inclose some remarks in regard to the above occurrence, as the case is not only a specially bad one, and one in which the blame comes squarely home to the guilty party, but also because the case is a perfectly fair specimen of the reckless system of highway bridge-work in America. I am aware that a more proper place for this communication would be in the columns of the *Engineering News*. The editor of that paper, however, for some reason best known to himself, writes me that he does not regard the matter of sufficient interest to his readers to warrant his entering into a discussion of the Groveland disaster; a statement which I can hardly understand, inasmuch as the *Engineering News* has always set itself up as the special organ for information on exactly this class of work, and not a great while ago remarked editorially that it proposed to publish the details of just such disasters as that at Groveland, in order that the public might be able to judge between good and bad companies, and in one of its very last numbers intimated that the particulars of this very disaster would soon be forthcoming. If the Groveland case is not of sufficient interest for the readers of the *News*, certainly no case ever can be.

On the 14th of January last one span of the iron highway bridge across the Merrimac River at Groveland, near Haverhill, Mass., broke down beneath the weight of a four-horse team and a small amount of snow. This bridge was built in 1871–72 by the King Bridge Company, of Cleveland, O., and consisted of six spans of bowstring girder, each about 125 ft. long, and a draw of about 50 ft. The whole cost of the structure was $80,000, and the contract price for the iron work $28,000. The general dimensions of the trusses, of which there are two, placed 26 ft. apart, are as follows: Span, 123 ft.; height of arch, 12 ft.; the arch or bow made in the closed box form, 11 in. deep at crown and 13 in. deep at the ends. The lower, or horizontal chord, on each side, consists of two bars 6×1 in. each, placed on edge, and forged down at the ends to a 2¼ round bar, which is reduced to 2 in. at the screw thread. The ends of the arches rest in a cast-iron shoe, which latter rests on a cast-iron bed plate bolted to the masonry, with no provision for expansion, except so far as the shoe can, by overcoming the friction, slide on the bed plate. The floor beams rest directly on the upper edges of the chord bars, and the whole detail from one end of the bridge to the other is wretchedly defective, and an admirable illustration of how such work should not be done. The bridge is warranted in the contract to sustain 3,000 lbs. per lineal foot, besides its own weight, which latter cannot be less than 1000 lbs. per foot. The wonder is not that the bridge has broken down, but that it ever stood. It would certainly have been condemned the very day it was completed by any honest competent engineer.

The company which made that bridge agreed in the contract to give the county a structure which could carry safely 3,000 lbs. per lineal foot, besides its own weight; but they built a bridge which, if they knew enough to compute its strength at all, they knew perfectly well could not safely carry over one-fourth part of that load. In fact the weight of the bridge alone is the most that ever should have come upon it. The company warranted each span of that bridge to carry safely a net or moving load of 165 tons, and it broke down under a single team and a small amount of snow. The company warranted that bridge to carry a load which would strain the iron to 50,000 lbs. per inch, when it knew perfectly well that 15,000 lbs. per inch was the very utmost that could safely be borne. The papers have stated that the weight of snow that lay upon the bridge was the cause of the disaster, and that the town should not have allowed such an accumulation to take place. This is all pure nonsense. The bridge was expected to hold all the snow that could fall upon it. The county paid for an ample strength for all such contingencies, and had a perfect right to expect it, and was not obliged to clear the snow off at all. The county paid for a bridge which should carry safely 3,000 lbs. per lineal foot, besides its own weight. This is at least 50 per cent. more than the weight of a solid line of locomotive engines from one end of the bridge to the other.

Just when the remaining four spans of the Groveland bridge are going to fall is a matter which concerns those who travel over it, and those who will have the bills to pay in case of the further disaster which is perfectly sure to come, as the six spans were all alike, and the five that remain have only to be looked at to be condemned; but the lesson which the fall of this bridge teaches is of vital importance to the whole country, since there are hundreds of cheap iron highway bridges now in use on our roads just as bad as the one at Groveland, and many of them worse; many of them built by the same bridge company—on exactly the same plan. This very concern built an iron bridge at Brunswick, Me., in 1877, which was warranted to hold safely 2,240 lbs. per lineal foot, when the very simplest computation shows beyond all question that such a load would cripple the bridge, if it did not break it down. The case was so bad that the town called an expert examination, which condemned the bridge in the most decided manner, and at the same time accused the builders of the most bare-faced dishonesty. In the face of these facts, the same company directly afterwards built another bridge, only four miles distant, just exactly as bad as the condemned one, and the County Commissioners, in full knowledge of all the facts, paid for it and it is now in daily use, and liable to fall at any moment.

The King Bridge Company is not the only one which builds these wretched traps. There are several concerns which make a specialty of highway bridges, and which, taking advantage of the ignorance of public officials, are flooding the country with bridges like that at Groveland. On an average at least twenty of these miserable traps tumble down every year, and nothing is done to bring the guilty parties to punishment. Dishonest builders cheat ignorant officials, and the public suffers the damage and pays the bills. Is human life worth enough to pay for having these structures inspected, and if found unsafe strengthened or removed?

I have read carefully the contract between the bridge company and Essex County for the Groveland bridge. It is hardly worth the paper it is written on. No engineer could possibly tell from that document whether the county was going to get a bridge or not; and such as it is, it is violated outrageously right straight through; and the County Commissioners did not know enough to see how badly they were cheated; and what was worse they did not know enough to feel their own incompetence, nor to get an engineer to accept the work for them; and these men represent very fairly the common practice in such business throughout the country. In fact, considering the number of disasters we have had, those who are cheated in this highway bridge business are about as much to blame as the dishonest bridge-builders who cheat them.

Whether it is now possible for the county to recover the price of the Groveland bridge from the builders is a question. Unless the bridge company is prepared to admit that it does not know enough to compute the strains on a simple bowstring girder, it will be forced to confess that it warranted that a piece of wrought iron should safely hold 50,000 lbs. per inch, when it knew perfectly well that 15,000 lbs. was the largest safe allowance. If that company knew enough to tell the difference between a good bridge and a bad one, it knew perfectly well when it built the Groveland bridge that it was making a wretchedly unsafe trap, and was cheating the county.

It is useless to speculate as to the cause of the Groveland disaster. Just why that particular span fell is not a matter of the slightest moment. The whole bridge condemns itself at once, on inspection. The fact that the bridge had been "tested" when completed amounts to nothing whatever. The fact that the county commissioners were entirely satisfied with the bridge means nothing, as they knew nothing about such matters. The fact that the bridge had long been regarded as unsafe, and no precautions were taken to guard against disaster, does not exonerate in the slightest degree either the company which built it or the commissioners who accepted it.

The fact that no one was killed by the fall of the bridge at Groveland will of course, as usual, prevent any noise being made about it in the papers; but the blame remains the same. Knowing now the fact that at least 20 highway bridges fall every year, is it, or not, worth while to have any system of control of such works as shall prevent these disasters? Can we do anything to prevent towns and counties from being imposed upon by dishonest builders? We certainly can if those who control these matters care enough about it to do it. There are two ways of getting a bridge, a good way and a bad one. I will show what these two ways are so plainly that no one can misunderstand.

TO BUY A BAD BRIDGE.

Just as soon as your town or county votes money for a new bridge, certain agents—and they are as numerous as the agents for sewing machines or lightning rods—will call on or write to the town or county officers, and will offer to build anything under heaven you want, of any size, shape or material, and for almost any price. They will produce testimonials from all the town and county officers in the country for the excellence of their bridges, and would not hesitate to give reference even for their moral character, if you should ask it. If they find that you don't know anything about bridges, they will, to save you the trouble, furnish a printed specification, which document will commit you to pay the money, but will not commit the bridge company to any thing at all. When the bridge is put up, you never will know whether the iron is good or bad, nor whether the dimensions and proportions are such as to be safe or not. You will know that you have paid your money away, but you never will know what you have got for it until some day when your bridge gets a crowd on it and breaks down, and you have the damage to pay. This mode of buying a bridge is very common.

TO BUY A GOOD BRIDGE.

First, determine precisely what you want, and if you don't know anything in regard to bridge-building yourself, employ an engineer who does, to make a specification, stating exactly what you want, and what you mean to have. Then advertise for bridge-builders to send in plans and proposals. Let the contractors understand that all plans and computations are to be submitted to your engineer, that all materials and workmanship will be submitted to your inspectors, and that the whole structure is to be made subject to the supervision of a competent engineer, and accepted by him for you. You will find at once that under such conditions all traveling agents and builders of cheap bridges will avoid you as a thief does the light of day. You will have genuine proposals from responsible companies, and their bids should be submitted to your engineer. When you have made your choice, let the contract be writ-

ten by your lawyer, and have the plans and specifications attached. Employ a competent engineer to inspect the work as it goes on, and when it is done you will have a bridge which will be warranted absolutely sound by the best authority. This mode of buying a bridge is very uncommon.

I am not so unacquainted with town and county officers as to suppose that the second method given above will commend itself to many of them. Still, if only a few accept the suggestion, it will be the beginning of a better state of affairs.

There is no need of ever building or having unsafe bridges. Honesty and intelligence will always get a first-rate structure, whether it be of wood or iron. Dishonesty and stupidity will always get a bad bridge, whether it be of iron or wood. It lies with the public to say whether it will have good bridges or bad ones.

GEORGE L. VOSE.

Widening Gauge on Curves.

NEW YORK, Jan. 31, 1881.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Mr. Doane's reply to my note of a couple of years ago shows a lamentable state of ignorance, either in this country or abroad. If the table quoted by me be correct practice for the long and rigid wheel-base of foreign cars, surely Mr. Doane must be in error in using practically the same figures for our swing trucks with their very short wheel-base.

I think Mr. Shunk, if asked, would gladly give you the results of his studies while engaged in perfecting his track scheme for the Metropolitan Elevated. If I remember rightly, he only allowed ¾ in. additional width of gauge on the 60° curves at Murray street. I wonder Mr. Huntington has never been tempted to give us his views on the subject.

SULLIVAN HASLETT.

Toucey and Buchanan's Interlocking Switch and Signal Levers.

Probably all railroad managers who have had any considerable amount of experience have learned that railroad switches have a remarkable propensity of being wrong when they should be right, or open when they should be closed, and closed when they should be open. It is somewhat singular, too, that the men who are placed in care of them seem in time to absorb somewhat of the same perverse characteristics. They will perform their duties in a perfectly reliable and rational way for years, when all of a sudden they will do some most preposterous thing which will cause a terrible accident and the loss of much property and may be destruction to life or the injuring of many persons. No human foresight can tell when men who have always been careful and prudent may fail in this way in the performance of their duties.

If a switch happens to be set wrong, the difficulty usually is to stop the train in time to avoid an accident. The means of doing this is, of course, to provide improved brakes under the control of the locomotive runner, which can be applied the instant that he discovers the danger. But if the rate of speed of trains is high, or the view of the switch and its signal is in any way obstructed, it is desirable to place a signal some distance, say one or two thousand feet, back of it, so that the locomotive runners may be informed of its position at a sufficient distance to be able to stop their trains before they reach the place of danger. If a distant signal is used, there will, of course, be some risk that it may not be set in the position to correspond with that of the switch. To guard against such a mistake is the object of the apparatus illustrated by our engravings, which is now being introduced very extensively on the Hudson River Railroad.

The general arrangement of the apparatus is shown by fig. 1, which is an elevation looking lengthwise of the track, and fig. 2, which is a plan of a switch. There is in the first place a cast-iron stand, *S*, which supports two levers, *A'A*, only one of which is seen in fig. 1; the other one is exactly like it, but, being behind, it is not shown. This stand and the levers are represented in an enlarged scale in figs 3 to 6. One of these levers, *A*, figs. 1 and 2, is connected by a rod, *A C*, with a cam, *e*, which works in a slot in the cross-bar, *d*, which connects the two switch rails. It will be readily seen that the movement of this cam will throw the switch rails from one track to the other. It will also be seen that when the cam is in the position represented it will effectually hold the rails in the position they occupy, and that their movement has little or no tendency to shift the position of the cam. The latter thus locks the switch rails in their position. It also acts in the same way when it is moved into the opposite position, when the switch rails are connected with the side-track.

Between the stand, *S* (figs. 1 and 2), and the track a short, hollow, cast-iron column, *B*, is placed to which a semaphore arm, *C*, is attached by a pivot at *g*. Figs. 7 and 8 are enlarged views of this post and semaphore. At the base of the column is a bell-crank, *f*, fig. 7, which is connected with the lever *A*, fig. 1, by a rod, *h*, and also with the semaphore arm by a vertical rod, *p* (figs 7 and 8), on the inside of the column and represented by dotted lines. It is evident that the movement of the switch lever will thus simultaneously either raise or lower the semaphore arm *C*. This arm has a colored glass lens, *l*, fig. 7, which, when the former is lowered, comes in front of a lamp, *L*, fig. 8, attached to the post. When the arm is lowered into the position shown in fig. 7, the lens is in front of the lamp and it then shows a colored, usually green, light, and when raised as in fig. 1 the light appears white.

This switch or home signal is raised to indicate "line clear," whereas the distant signal is lowered. Both, however, mean danger when extended at right angles to the post. It would seem to be better, to avoid confusion, to have them both move the same way.

In figs. 1 and 2 the switch is represented as set for the main track, and the semaphore *C* is raised to the vertical position shown. If the switch was moved to connect with the side-track by throwing the lever *A* over into the position indicated by the dotted lines *m m*, fig. 1, the semaphore arm *C* would be at the same time lowered into the position *C'*, also indicated by dotted lines. The movement of this semaphere is thus simultaneous with that of the switch lever.

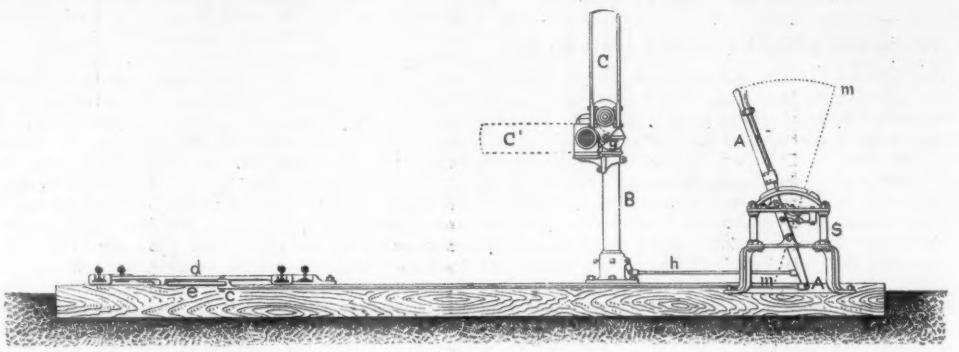


FIG. 1.

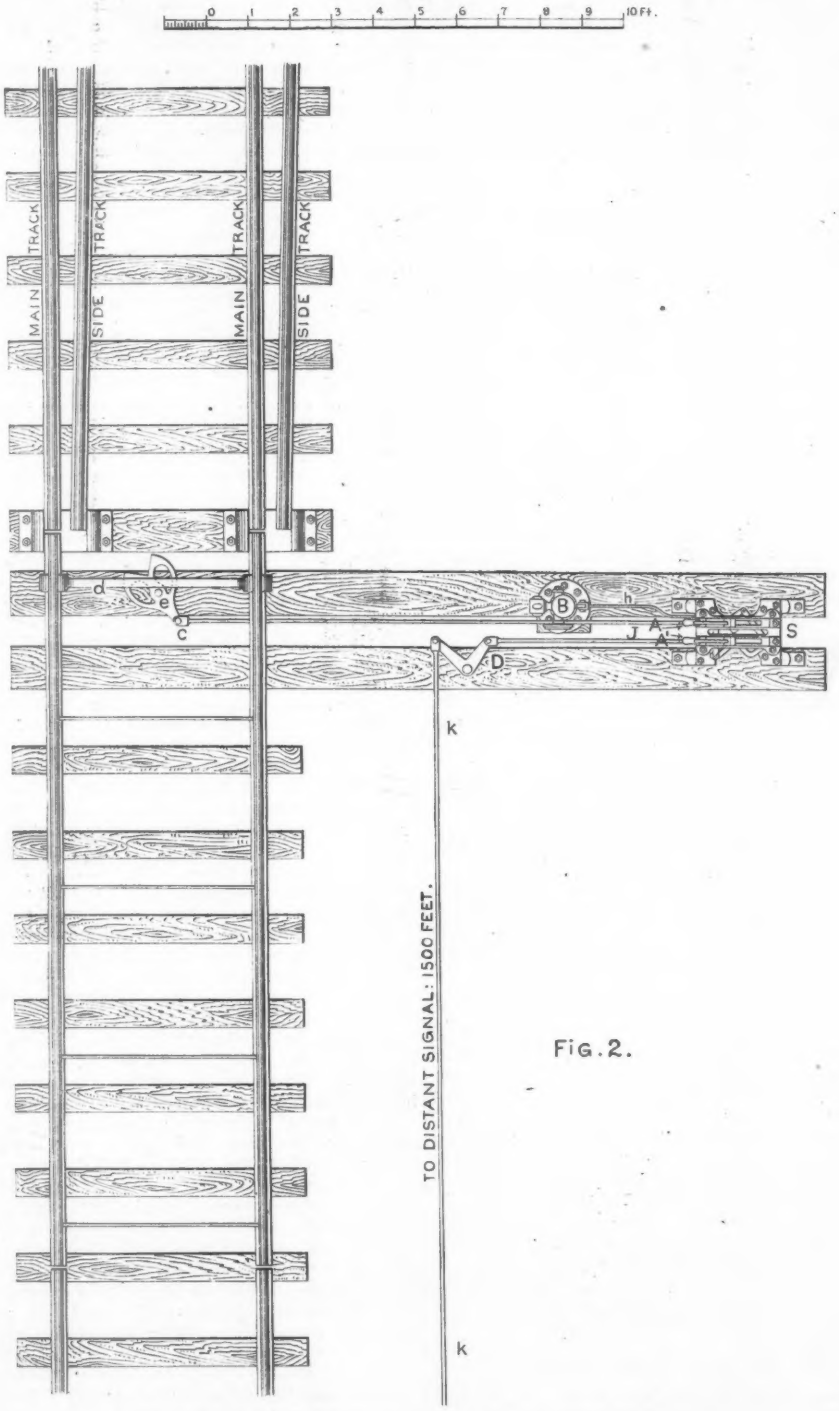


FIG. 2.

INTERLOCKING SWITCH AND SIGNAL APPARATUS.

But, as already explained, for safety it is desirable to give warning some distance back of the switch.

For this purpose a post with a semaphore similar to *C* is placed about 1,500 ft. from the switch. Complete illustrations of such a post and signal were given in the *Railroad Gazette* of Oct. 4, 1878, so that it will not be necessary to repeat them here. This semaphore or distant signal is operated by the second lever, *A'*, fig. 2, attached to the stand *S*. This is connected by a rod, *J*, with a bell-crank, *D*, and that is connected by a wire or wire-rope, *k k*, with the distant signal. It is evident, however, that in operating the switch and the signal by means of the two levers, the switchman might make a mistake or forget to place the distant signal to indicate danger when the switch was set for the side track, and thus run it on the latter or throw it off altogether. As stated before, it is this danger that the apparatus illustrated is intended to guard against. This is done by a mechanism which "interlocks" the one lever with the other, so that the switch cannot be moved to connect with the side track until the distant signal is set to indicate danger, and when the switch is set for the side-track, the distant signal cannot be lowered to indicate line clear until *after* the switch is moved back to connect with the main track.

The mechanism by which this is effected is represented by figs. 3, 4, 5 and 6, which are side and end views and plans, respectively. The lever *A* operates the switch and *A'* the distant signal. In the position in which the levers are represented in figs. 3, 4 and 5, the switch is set for the main

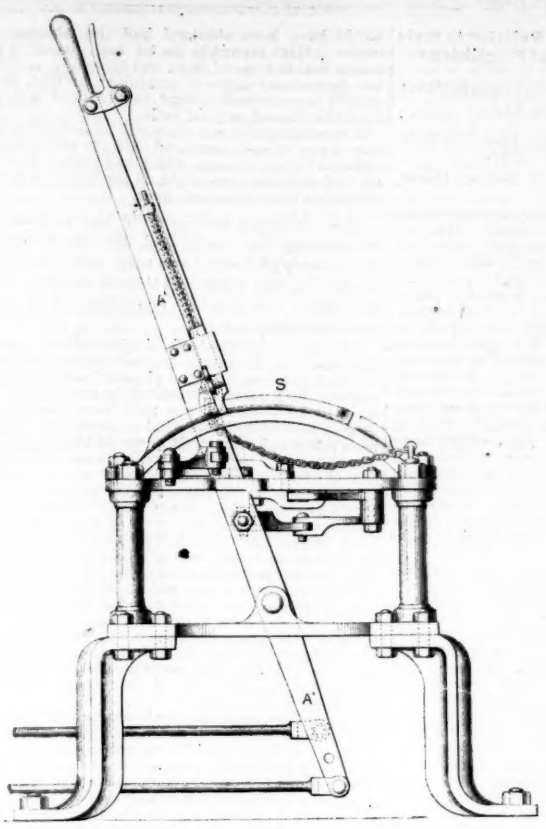


Fig.3.

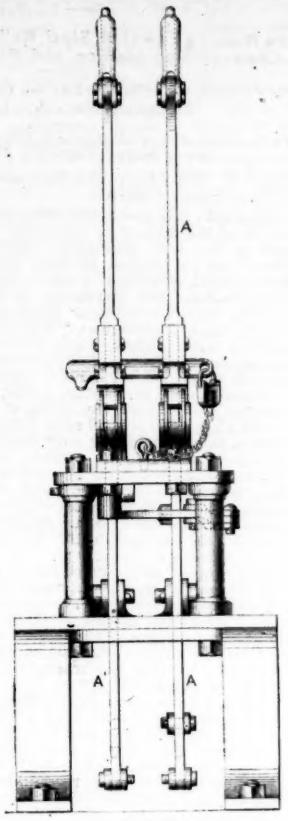


Fig.4.

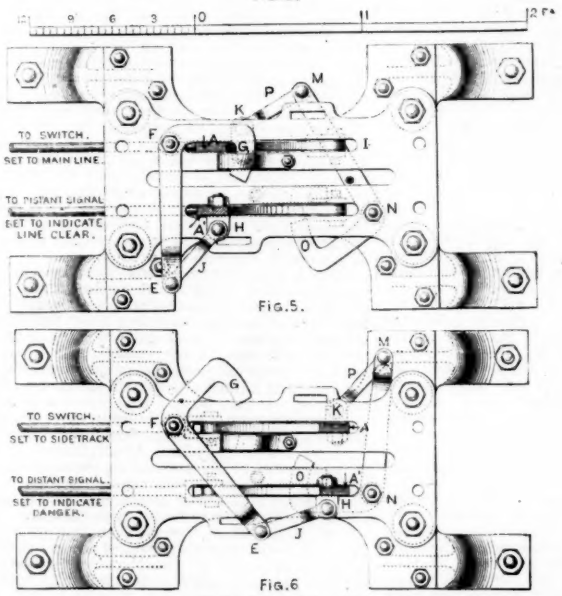


Fig.5.

Fig.6

INTERLOCKING SWITCH AND SIGNAL APPARATUS.

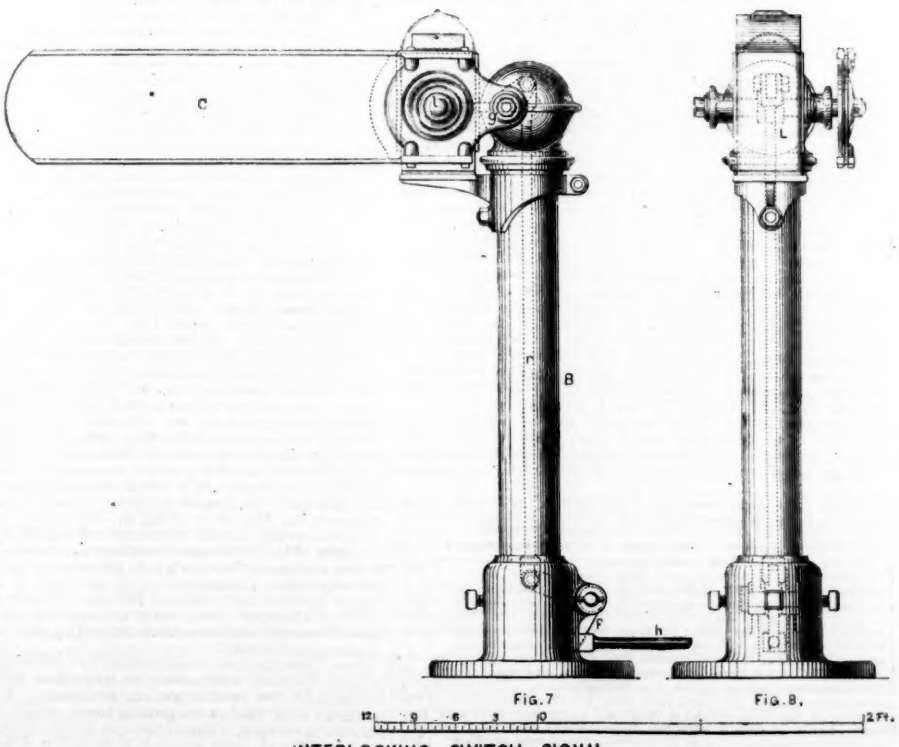
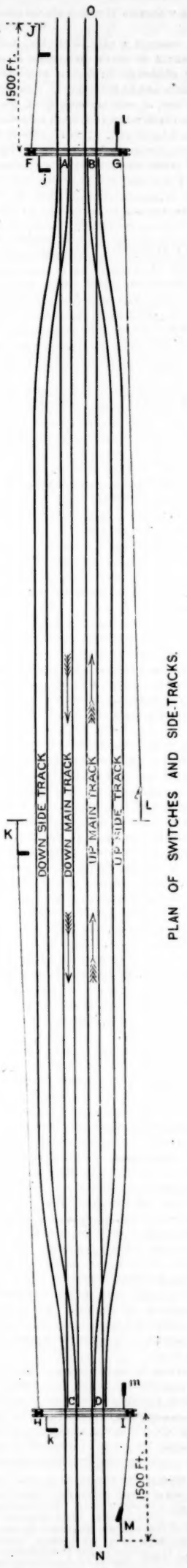


Fig.7

Fig.8.

INTERLOCKING SWITCH SIGNAL.



PLAN OF SWITCHES AND SIDE-TRACKS.

Fig.9.

track, and the distant signal is placed so as to indicate line clear.

In fig. 5, which is a plan, with the sectors *S* removed, and the levers *A A'* shown in section, it will be seen that there is an *L* shaped latch, *E F G*, which is pivoted at *F*. A stud, *H*, is attached to the lever *A'*, and the former is connected by a link, *J*, with the end, *E*, of the L-shaped latch. It will be seen that when this latch is in the position shown in fig. 5, the hooked end, *G*, will prevent the lever *A* from being thrown over towards *I* or to the right. If, however, the lever *A'* is moved to the right, as shown in fig. 6, then the latch *E F G* is also moved by the link *J* into the position represented in fig. 6. This, it will be seen, releases the lever *A* and permits it to be moved to the right, in which position it is shown in Fig. 6. In fig. 5 another L-shaped latch, *M N O*, is shown. This is connected by a link, *P*, to a stud, *K*, on the lever *A*. As stated before, the movement of the lever *A'* to the right, as shown in fig. 6, simultaneously moves the latch *E F G*, which releases the lever *A*, and the latter can then be thrown over to the right, as shown in fig. 6. This movement of the lever *A* also simultaneously moves the latch *M N O* into the position indicated in the same figure. It will be seen that it then in turn locks the lever *A'*, so that it cannot be thrown to the left or to its first position.

Now let us see what the consequence of this arrangement will be. In figs. 3 to 5 the switch lever *A* is set so that the switch connects with the main line, and the signal lever is placed so that the distant signal indicates line clear. Before the switch can be moved or disconnected from the main line, the signal lever *A'* must *first* be moved into the position shown in fig. 6. In doing this the distant signal is placed so as to indicate danger. In other words, it is impossible to move the switch into a dangerous position without first displaying a danger signal at a distance of 1,500 feet from the former. When the danger signal is displayed and the switch moved so as to connect with the side-track, in which position the levers are shown in fig. 6, then it is impossible to lower the danger signal until *after* the switch is moved to connect with the main line.

Thus the switch can never be moved unless the distant signal is set to indicate danger, and the latter can never be lowered to indicate line clear unless the switch is set to connect with the main track. The apparatus, in fact, so far as the display of the signals and the movement of the switch are concerned, endows a switchman with infallibility.

The general arrangement of the signals and switches for the sidings of a double-track road is shown by the plan, fig. 9, in which *A*, *B*, *C* and *D* are the switches, which each have stands *F*, *G*, *H*, *I*, and levers such as have been described. The switches *B* and *D* of the up main track are represented as set for the main line, whereas those for the down main track are set for the siding; *j*, *k*, *l*, *m* are the switch or home signals and *J*, *K*, *L* and *M* are the distant signals.

Let us suppose now that an up train is approaching the switch D from *N*. Before it reaches a point 1,500 feet from the switch, the distant signal *M* will indicate the position of the switch. After passing *M*, the switch signal will also show him the switch is set. After passing *D*, the signal *L* will show the position of *B* so as to give time and space to stop before it is too late, and *l* will show the position of *B* as soon as it comes in sight. It would be possible, of course, to set the switch for the main track and at the same time leave the distant signal to indicate danger, but in that case the only harm done would be to stop the train unnecessarily, and usually the execrations of the train-men on such occasions prevent an undue frequency of such carelessness on the part of the switchmen.

On the down track the switch *A* is represented as set for the siding, and the signal *J* and *j* are then placed to mean danger. An approaching train is warned by *J* at a distance of 1,500 ft. from the switch, and afterwards its position is made apparent by the home signal *j*. The signals *K* and *k* will indicate the same thing for the switch *C* in approaching it.

On roads running very fast trains or with much traffic, a system of distant signals for all main-line switches seems to be essential for safety, and if they are used, some system of interlocking them in relation to each other is absolutely essential to prevent mistakes. When such apparatus is used, it also has the advantage that it compels a switchman to make a preliminary movement of the distant signal lever before the switch lever is released. This gives an interval for reflection, and in a great measure is a preventive of that peculiar confused state of mind in which switchmen do just the reverse of what they should and probably would do if they reflected for an instant. Mechanism of the kind described compels some momentary delay, and that delay must always be guarded by a danger signal, or the necessity of displaying one.

This apparatus is the invention of Mr. Toucey, the Superintendent, and Mr. Buchanan, the Master Mechanic, of the Hudson River Division of the New York Central & Hudson River Railroad, and is manufactured by the Toucey & Buchanan Switch & Signal Company, of Harrisburg, Pa., to which inquiries for further information should be addressed.

—Major George R. Wilson, well known at the South as an engineer, died in Shreveport, La., Jan. 30. He had been in failing health for over a year. He was born in Pennsylvania in 1832, graduated at West Point in 1854, and, after serving a few years in the Engineer Corps, resigned and was made State Engineer of Louisiana, holding that position until 1861. He served in the Confederate army, and after the war was employed as engineer on the New Orleans, Jackson and Great Northern, the Vicksburg, Shreveport and Texas, the Southern Pacific (of Texas), and lastly on the Texas and Pacific. In 1876 he went to Guatemala in the service of the government of that country, whence he returned in 1879, and was employed on the improvement of the Red River till his health failed.

The Wearing Power of Steel Rails in Relation to their Chemical Composition and Physical Properties.*

BY CHARLES B. DUDLEY, PH. D., CHEMIST, PENNSYLVANIA RAILROAD COMPANY, ALTOONA, PA.

[To be read at the Philadelphia meeting of the American Institute of Mining Engineers, Feb. 17, 1881.]

Theo. N. Ely, Esq., Superintendent of Motive Power, Pennsylvania Railroad.

DEAR SIR: It is now nearly three years since my first report to you on the subject of steel rails was written. The report, as you will remember, dealt principally with the question of the relation between the chemical composition and physical properties of steel rails and their power to resist crushing and fracturing in actual service. Other matters were referred to or touched upon in that report, but the main question was, "Why do some rails crush or break in service, while others do not?" You will doubtless remember that the principal conclusion arrived at was that the softer rails are less liable to crush or break in service than hard ones; or, in other words, so far as conclusions could be drawn from the chemical analysis and physical test of 25 samples of steel rails which had actually been in service, these conclusions were that those rails which have the smaller amounts of carbon, phosphorus, silicon, and manganese are less liable to crush or break in service than those which have larger amounts of these elements. Or, again, looked at in the light of physical tests, those rails which have the lower tensile strength and the greater elongation are the ones which gave the least trouble from breaking or crushing in track.

In the report just referred to, the question of the wearing power of steel rails was not made prominent, and from that report no positive and definite information could be obtained as to what quality of steel would give rails that would endure the greatest amount of traffic with the least loss of metal. And yet of the three principal causes which occasion the removal of rails from the track, viz., broken, crushed, and worn out, perhaps the latter is of the most importance. With the improvement in maintenance of way, which has characterized the Pennsylvania Railroad during the last five or six years, the removal of rails from track from the first two of these causes has, if I am right, quite notably diminished. This certainly is true with regard to broken rails. And if, as time advances, the number of crushed rails shall diminish, both because of the continued improvement in maintenance of way, before referred to, and because, owing to improved and better methods at the steel works, there are fewer crushed rails caused by physical defects in the steel, the question of the wearing power of steel rails obviously becomes the all-important one. In view of these considerations, it was thought that an investigation into the relation between the wearing power of steel rails and their chemical composition and physical properties could not fail to throw light upon a question of vital importance in the management of the Pennsylvania Railroad. The results of such an investigation are presented in the following report, which deals, not as did the previous report, with the relations between the chemical and physical characteristics of steel rails and their power to resist crushing or fracture, but entirely with the relation between these characteristics and wear.

On any railroad the rails are, or may be, called upon to perform their service under quite varying conditions. On a railroad like the Pennsylvania Railroad, for example, there are levels and grades, and there are tangents and curves, and there are combinations of the levels and grades with the tangents and curves. Moreover, the rails on the high sides of curves do their service under different conditions from those on the low sides of curves. So that as far as kind of service is concerned, a rail may be called upon to do its work under one of these conditions, viz., on level tangent, on high side of level curve, on low side of level curve, on grade tangent, on high side of grade curve, or on low side of grade curve. Any investigation, therefore, into the wearing power of steel rails, which shall be of service in determining what rails are best for the whole road, must take into account these six conditions. Of course there are many different grades and curves of different radius on the Pennsylvania Railroad; but to study wear on each grade, and for every radius of curvature, would make a problem almost lifelong. In order, therefore, to make the work manageable it becomes necessary to choose some average grade and some medium degree of curvature, as representing the different grades and curves on the road. This has been done in the work about to be described.

Now, the problem before us is: What chemical composition and what physical properties are characteristic of those rails which in actual service have lost least metal in proportion to the tonnage that has passed over them? In order to get the information necessary to answer this question, 64 rails were taken from the track in July, 1879, and subjected to chemical analysis and physical test, as is detailed further on. Sixteen of these rails were taken from level tangents and 16 from level curves, 8 from the high side and 8 from the low side of the curves. Again, 16 rails were taken from grade tangents and 16 from grade curves, 8 from the high side and 8 from the low side of these curves. The 32 rails on grades were all taken between Conemaugh and Altoona, and the 32 on levels between Tyrone and Mifflin. Furthermore, 32 of the rails were taken from the north track, and 32 from the south track. The principle governing the selection was to secure 8 as slow-wearing rails and 8 as rapid-wearing rails as could be found on each of the four conditions of service—level tangents, level curves, grade tangents and grade curves—the rails on curves being taken, as has already been described, one-half from the high side of the curve and one-half from the low side of the curve. In the actual selection a pair of callipers was used, and the loss in height of a rail, compared with its time of service, gave a sufficiently accurate measure of the rate of wear of a rail to determine its selection. It should be stated here that since the rails were selected in July, after the usual annual removal from the track of wornout rails, which takes place earlier in the season, the more rapid-wearing rails obtained for examination are not as marked examples of rapid-wearing rails as would have been obtained had the selection been earlier made. With regard to the 64 rails chosen, it may also be stated that not one of them had broken in service, and only one showed any signs of crushing; so that, as far as every quality is concerned, except their rate of wear, all of them might be classed as good rails.

It was thought that a chemical examination and physical test of the 64 rails compared with the loss of metal they had suffered by the tonnage which had passed over them, could not fail to throw some light on the question as to what kind of steel in rails gives best wear.

[Here follows a description of the methods employed in determining the weight and amount of wear of each rail, the manner of testing the rails, and a description of their locality in the track and time of service. This portion of the report and also the engravings of the rails we have omitted.—EDITOR.]

Accompanying Table No. I. gives all the essential data of the history of the rails, together with the chemical analyses, weights, and results of the physical tests, as has been before stated. To a study of these tables attention is now directed. As will be observed, the rails have been arranged in six groups, according to the kind of service to which they have been subjected. The first group of 16 rails did their service on grade tangents; the second group of 8 rails on the low side of grade curves; the third group of 8 rails on the high side of grade curves; the fourth group of 16 rails on level tangents; the fifth group of 8 rails on the low side of level curves; and the sixth group of 8 rails on the high side of level curves. As will likewise be observed, the rails within the groups have been arranged in regular order according to loss of metal per million tons, the rail having lost least metal per million tons being placed first. The first rails in the several groups are therefore the slow-wearing, while the latter rails are more rapid-wearing. This arrangement enables us to compare the slower-wearing rails of the different kinds of service with the more rapid-wearing ones, and to discover what physical qualities, and what chemical composition, are characteristic of the slower-wearing as well as the faster-wearing rails.

Giving our attention now to the tables, I think the first observation will be that there is no absolute gradation in physical qualities, or in chemical composition, applying to every rail in each group, which corresponds to the gradation in amount of metal lost per million tons. In other words, if we take tensile strength, or elongation in the physical qualities, or the carbon or phosphorus in the chemical composition, we do not find that the first rail in each group is characterized by a certain figure in any one or more of these respects, while the last rail of the group is characterized by another different figure, and all the intermediate rails arrange themselves in respect to any of these peculiarities, between these two extreme rails of the group. Nor do I think we ought to expect such uniformity, and for the following reasons:

First. Whatever errors there may have been in determining the loss of metal of these rails or in the tonnages, as has been before described, will of course have an influence in determining the position of any rail in the group to which it belongs. And, as has already been said, while I do not think that these errors, whatever they may be, are sufficient to seriously obscure or counteract the general conclusions which the results are calculated to teach, yet these errors may possibly be large enough to give some rail a position in the group which it should not occupy.

Second. I am not aware that it is known as yet exactly what *wear* is, or what it is dependent upon. Some considerations in regard to the nature of wear will be advanced further on; but whether wear is a direct function of the tensile strength of steel, or of its elongation, or of its elastic limit, or of its resilience, or any combination of these, or indeed, as seems somewhat probable, of the amount of distortion by bending that a piece of steel will suffer, is a problem yet to be solved. It may be that wear bears a direct ratio to the elongation within the elastic limit, or to the amount of work done within the elastic limit whenever a particle is worn off; or, indeed, wear may be a direct function of the granular structure of steel, the wear being more rapid as the granular structure is coarser, or *vice versa*. Or, finally, wear may be due to a combination of causes, and each cause may require for its elucidation a different physical test. It is, perhaps, therefore, not strange, in view of this want of knowledge, that in a series of steels arranged according to loss of metal, or on the principle of wear, the physical qualities which we are now able to measure should not show uniform gradations throughout the series. But, it seems to me, this reasoning does not tend to throw doubt on our ability to draw conclusions that will be valuable from the work which we have in hand. For the question we are studying is not what does wear depend upon, but what chemical composition, and what physical properties, are, in general, characteristic of such rails as have in actual service given least loss of metal per million tons' burden. While the answer to this question may not solve the whole problem of wear, yet it cannot fail to throw light on the relation between the chemistry and physics of steel and its wearing power, which, after all, with our present knowledge of steel metallurgy, is all the knowledge we are able to utilize.

Turning our attention now again to the tables before referred to, I think that, notwithstanding we do not find absolute uniformity, as has just been explained, yet no one can fail to observe, in general, a difference, both in physical properties and in chemical composition, between the slower-wearing and the more rapid-wearing rails. Thus, in regard to the physical properties, I think it is entirely evident to inspection, that, in the torsion tests, the slower-wearing rails in each group, except perhaps on the high sides of curves, are characterized in general by lower height and greater length of diagram. In the tensile tests, again, the slower-wearing rails are, in general, characterized by lower tensile strength and greater elongation than the more rapid-wearing ones. In the shearing tests, the same thing appears, viz., in general, lower shearing stress and greater detrusion. And in the bending tests we see the same result, perhaps more strongly than in any of the other tests, viz., that the slower-wearing rails are, in general, those which have the lower bending stress and the greater amount of deflection before rupture. In density, as would be expected, the slower-wearing rails have the greater density. Again, in the chemical composition, the same thing is observable, viz., that the slower-wearing rails are characterized in general by the lower amounts of the substances determined, carbon, phosphorus, silicon and manganese, while in phosphorus units, which, as you remember, I suggested as an attempt to measure, in a degree at least, the combined influence of these substances on the steel, the same thing may be seen, viz., in general, the slower-wearing rails are characterized by the lower numbers of phosphorus units.

Now, how shall we render evident to ourselves, in a more tangible manner, what seems, on inspection, to be the general teaching of the results we are studying? I know of no method except that of combining these results together and forming averages. This, I believe, is the universal method applicable to all cases where it is desired to draw conclusions from results embracing a number of samples. If, therefore, we make a series of averages of the results obtained, the in-

*At the Lake George meeting of the Institute in October, 1878, I had the honor of presenting to the Institute, through the kind permission of the officers of the Pennsylvania Railroad Company, the results of a study of 25 samples of steel rails, which had all been in actual service. Considerable discussion followed the publication of that paper, and there seemed to be a strong disinclination, especially on the part of the steel-rail manufacturers, to accept the conclusions presented. One of the principal objections urged against the conclusions drawn was, that they were based on too few samples; in other words, that no conclusions safe to act upon could be drawn from the examination of 25 rails. In view of this criticism it was decided to repeat the investigation with a large number of samples, and with the aid of the experience gained in the first investigation. The results of this second study of steel rails are, by the permission of the officers of the Pennsylvania Railroad Company, herewith presented to the Institute, with the sincere desire that they may aid in adding to our knowledge of this most important product. Like the previous paper, this is in the form of a report to one of the officers of the company, which will account for the style, and the manner of presenting the data.

dividual peculiarities of the different rails will, to a certain extent, disappear, and the general conclusions become more evident.

Accompanying Table No. II. gives a number of such averages. The first (horizontal) line on this plate gives the averages obtained from combining together all the essential data of the eight slower-wearing rails of the first group. The second line gives the same data for the eight more rapid-wearing rails of the same group. The next ten lines give the corresponding averages obtained from the remaining five groups. Turning our attention now to these averages, I think the same general conclusions which we have already obtained become still more clearly evident, viz., that, perhaps with the exception of the rails on high sides of curves, the slower-wearing rails in each group are in general characterized by those peculiarities which we are accustomed to comprehend under the general term softer steel; that is, in general, diagrams of less height and greater length, lower tensile strength and greater elongation, lower shearing stress and greater detrusion, lower bending stress and greater deflection, and lower amounts of carbon, phosphorus, silicon, and manganese, and lower phosphorus units. The exceptions to the law, if we may so call it, will be readily noticed, and are, perhaps, inseparable from averages formed from so small a number of samples as are some of these. The rails on the high sides of curves will be noticed further on.

With regard to the averages under consideration, it is perhaps interesting to notice that the slower-wearing rails are characterized throughout the whole series by lower height of diagram and lower elastic limit in the torsion tests, by lower elastic limit in the annealed tensile tests, by lowe bending stress and greater deflection in the bending tests, by lower phosphorus and lower manganese in the chemical analyses, by lower phosphorus units and by greater density. It should be remarked that the high average silicon of the slower-wearing rails on grade tangents is caused almost entirely by rail No. 881, a rail whose chemical composition and physical properties are certainly anomalous. This rail has 0.48 of silicon together with high carbon and manganese, and yet it gives with high tensile strength, as would be expected, a very good elongation. I may add that three determinations of the silicon in this rail were made, in order to be sure that there was no error in the work. The peculiarities of this rail cause the average of which it forms a part to differ from the other averages of the slower-wearing rails in several particulars. If this rail is thrown out, and an average made from seven rails instead of eight, all the data fall more nearly into line with the averages of the slower-wearing rails in the other groups. Thus, to give two or three examples, the average tensile strength of the unannealed tests becomes 75,143 lbs. instead of 79,625 lbs.; the elastic limit of same tests, 35,000 lbs. instead of 37,625 lbs.; the tensile strength of the annealed tests, 75,428 lbs. instead of 78,250 lbs.; the carbon, 0.301 instead of 0.324; the phosphorus, 0.082 instead of 0.076; the silicon, 0.048 instead of 0.102; the manganese, 0.530 instead of 0.563; and the phosphorus units, 31.3 instead of 34.8.

With regard to the rails on the high sides of curves, it will be observed that they do not seem to be governed throughout by the same laws as the remaining groups. Whatever may be the reason for this no one can fail to observe indications, which seem to point in the direction, that on the high sides of curves the harder rails give the better wear. This is especially noticeable in the group of rails on the high sides of level curves. It is, nevertheless, to be observed that in some of the data, especially height of diagram and elastic limit in the torsion tests, elastic limit in both the annealed and unannealed tensile tests, in the shearing tests, in the deflection of the bending tests, and in the chemical composition, the groups of rails on the high sides of curves do not differ from the remaining groups. It would not be surprising if more extended data should show that a different quality of steel would give better wear on the high sides of curves than was found best in the other conditions of service. For on tangents, and on the low sides of curves, the kind of wear to which the rails are subjected seems to be different in its nature from the wear on the high sides of curves. On tangents, and on the low sides of curves, the loss of metal is apparently due to two causes: 1st and principally, to rolling friction; and 2d, to the sliding of the wheels. Now, on the high sides of curves, in addition to the loss of metal due to these causes, there is also that due to the flange of the wheels, or flange wear. Now flange wear may not only be different in its nature, but may also require different qualities in steel to most successfully resist it from what are found best where the rails are subjected principally to rolling friction. This point will be referred to again when we come to speak of the nature of wear.

Thus far we have confined our study to the consideration of averages obtained from the rails within each group. But if I am right, the value of averages increases with the number of samples from which they are derived. It will be instructive, therefore, to make averages of the slower and faster-wearing rails, embracing as large a number of samples as possible. But, as has just been noticed, the kind of wear to which rails have been subjected, whether rolling and sliding friction or flange wear, may have an influence. It will, therefore, perhaps be most instructive to make averages of all the rails which have been subjected to the same kind of wear, and see what their testimony is as to the physical properties and chemical composition of the slow-wearing rails. Now, 48 rails out of the 64 we are studying did their service under similar circumstances as to kind of wear; that is, 48 of the rails were on tangents and on the low sides of curves, and consequently had little or no flange wear, while 16 of the rails were on the high sides of curves, and were consequently subjected to both kinds of wear.

In accompanying Table No. II, line No. 13 gives the averages of the 24 slower-wearing rails, which did their service on tangents and on the low sides of curves, and were consequently subject to the same kind of wear; while line No. 14 gives the average of the 24 faster-wearing rails that did their service under the same conditions. Line No. 15 gives the averages of the eight slower-wearing rails that were on the high sides of curves, and line No. 16 the averages of the eight faster-wearing rails under the same conditions. What, now, do these four lines of results teach?

With regard to the first two of these four lines, inspection seems to me to show very clearly that the slower-wearing rails are characterized by those physical properties and that chemical composition which we are accustomed to comprehend under the term softer steel. In other words, we find that the slower-wearing rails are characterized by lower height and greater length of diagram and lower elastic limit in the torsion tests; by lower tensile strength, lower elastic limit, and greater elongation in the tensile tests; by lower shearing stress and greater detrusion in the shearing tests; by lower bending stress and greater deflection in the bending tests; by lower carbon, phosphorus, and manganese, with a trifle higher silicon (caused by rail No. 881, as has been before explained) in the chemical composition; by lower phosphorus units, and by greater density.

With regard to the next two lines, giving the averages of the rails on the high sides of curves, the testimony of the data is not uniform. The length and area of diagram in the torsion tests, and the elongation of the tensile tests, and also in a slight degree the carbon, indicate that the slower-wearing rails are the harder steel. In every other item of the data, however, the slower-wearing rails are characterized by the same peculiarities that we have noticed in regard to the other rails, viz., lower height of diagram and lower elastic limit in the torsion tests; lower tensile strength and lower elastic limit in the tensile tests; lower shearing stress and greater detrusion in the shearing tests; lower bending stress and greater deflection in the bending tests; lower phosphorus, silicon and manganese with lower phosphorus units in the chemical composition, and greater density. It may be that this want of uniformity in the data from the rails on the high sides of curves is due to the fact that our averages only embrace 16 samples, and it may be, on the other hand, that an indefinite number of samples would give the same results. Or, again, it may be that this want of uniformity is due to a fact that has already been stated, viz., that on the high sides of curves the loss of metal is due to a mixed wear, partly from rolling and sliding friction, and partly from flange wear. If a certain quality of steel most successfully resists loss of metal due to rolling and sliding friction, and a certain other quality of steel best resists flange wear, then certainly it is not strange that in results obtained from a series of rails, which have been subjected to both these kinds of wear at once, there should not be absolute uniformity. If in the case of every rail the loss of metal was due almost entirely to rolling and sliding friction, or, on the other hand, if the loss of metal was due almost entirely to flange wear, there is very little doubt but that the law would appear. But it is not difficult to conceive that there may be in any series of rails such a relation between the loss of metal due to both of these causes as to make it quite difficult to discover what kind of steel is best adapted to the high sides of curves.

Nevertheless, in an investigation of the extent of the one under consideration, perhaps the best that we can expect to do is to get indications, as far as may be definite conclusions, as to the kind of rail best adapted to resist wear on the road taken as a whole. It will, perhaps, therefore, not be wise to discuss further the peculiarities of steel rails best adapted to any one kind of service, but to ask: What is the teaching of all the results we have obtained? This teaching will of course become evident if we make two averages, the one of the slower-wearing, and the other of the faster-wearing rails, the two embracing the whole 64 rails.

In accompanying Table No. II., lines Nos. 17 and 18 give such averages. An inspection now of these two lines seems to me to present in a very striking light the differences in the results of the physical tests and in the chemical composition, which are characteristic of the slower-wearing and the more rapid-wearing rails. In every particular of physical test and of chemical composition, except a trifle higher silicon, which, as has been before explained, is caused by rail No. 881, the averages of the 32 slower-wearing rails are such as belong to what we are accustomed to call softer steel. In other words, the slower-wearing rails have, on the average, less height and greater length of diagram, with lower elastic limit in the torsion tests; lower tensile strength, lower elastic limit, and greater elongation in the tensile tests; lower shearing stress and greater detrusion in the shearing tests; lower bending stress and greater deflection in the bending tests; lower carbon, phosporus, manganese and phosphorus units in the chemical composition, and greater density. It seems to me, therefore, that so far as we may trust the teachings of 64 rails, all of which have actually done service, we can hardly escape the conclusion that the softer rails give the better wear.

In view of this conclusion, two questions very naturally arise:

1st. If the softer rails give the better wear why not make rails even softer than those in the series we are now considering; or, in other words, what is the limit of softness to which it is possible to go?

And, 2d. With our present knowledge of steel, is there any conception which will at all assist us in understanding why it is that the softer rails give the better wear?

As to the first question, I think almost every practical man will say at once: If your conclusions are correct that the softer rails give the better wear, why not make rails as soft as possible? Indeed, why not use iron rails instead of steel? In answer to this latter question I think it may be fairly said that such metal as is used for rails, which we are accustomed to call iron, is quite a different metal from that commonly called steel which is used for rails. From the processes used in their manufacture, iron rails are never free from slag, and lack homogeneity of structure, while steel rails, from their method of manufacture, are almost entirely free from slag, and are, or should be, practically homogeneous throughout. In the puddling process, by which the iron for iron rails is made, the metal, when taken from the puddling furnace, is a dripping mass of iron and slag, and the amount of slag that is removed is dependent, in great part at least, on the subsequent working. Furthermore, in the subsequent operations before the rail is finished there are plenty of chances for non-welding, so that an iron rail might almost be cited as an example of non-homogeneity of structure. In the processes by which steel rails are made, on the other hand, the metal previous to the formation of the ingot is in a state of fusion, thus allowing the almost complete separation of the slag, and the formation of ingots, from which rails are to be rolled, that are, or should be, practically homogeneous in structure. Now that rails made from ingot iron, if such a metal is possible—that is, iron which before it became an ingot was in a state of fusion—would not, in actual service, wear slower and lose less metal per million tons' burden that passed over them than even the best rails in the series we are studying, is an assertion which, I think, few men would be willing to make, and fewer still would be able to maintain.

But, it seems to me that there is a natural limit to the softness of steel for use in rails, which limit is determined by the service to which the rails are to be subjected. It is evident, I am sure, that besides their ability to successfully resist wear, and to withstand the shocks and blows to which they may be subjected, rails have also another very important duty, viz., they must be able to hold up the load which is to pass over them without being deformed or squeezed out of shape by this load. They must also have sufficient stiffness so as not to be bent down between the ties by the load, and thus give rise to a series of elevations and depressions in the track. To take an extreme case for an example, if we had a rail made of lead no one doubts but that it would entirely fail to hold up the load between the ties, and would on the ties be deformed and squeezed out of shape, probably, by the first train that passed over it. Now, those qualities of metal which enable it to hold up the load without bending, and to successfully resist deformation from compression, are generally comprehended with others under the term hardness. In other words, to apply this to the case we have in point, the harder the steel in the rails the less liable will they be to bend between the ties and to suffer deformation, or to squeeze out from the loads which are above them. Here, then, is the limit of softness. The steel in the rails must not be so soft that they will bend between the ties, or squeeze out of shape and become deformed from the compression due to the superincumbent load.

Just exactly where this limit shall be placed is, of course, a question to be decided by the weight of the locomotives and cars which are intended to run over the rail. On roads where the locomotives and cars are comparatively light, the rails could be made softer, and consequently, if our conclusions are correct, the loss of metal per million tons' burden would be less than on roads using heavier locomotives and freighting their cars with heavier loads. Just where this limit of softness is in the case of the Pennsylvania Railroad, it is of course impossible to say, but from an examination of all the rails which have been tested at Altoona, amounting to nearly a hundred samples, I think that steel which gives a tensile strength of 65,000 lbs. per square inch or over will give very little or no trouble from bending or deformation in the track. It may be that this limit might be still lower, but with our present knowledge of the subject, and without further experimentation, I should hardly like to recommend it. Another consideration comes in here, and that is, it is a little more difficult to successfully make soft steel than to make hard steel, and it may be, therefore, that the difficulties of manufacture will help to establish the limit of softness.

As to the second question: Is there any conception which helps us to understand why it is that the softer rails give the better wear? I will say that in view of our absence of knowledge as to exactly what quality or combination of qualities of steel wear is a function of, the answer to this question becomes difficult. Nevertheless we may possibly get a little help upon this point by devoting a few moments, to the consideration of what takes place when steel suffers loss of metal by wear. What then is the condition of the surfaces involved in wear? What are the forces which act and what are the strains produced?

If I understand the matter correctly, no two surfaces ever have been made, or can be made, that are absolutely smooth. At the very best, the smoothest surfaces are made up of elevations and depressions, very minute, it is true—perhaps almost infinitesimal and entirely incapable of measurement—but nevertheless real elevations and depressions. When these elevations and depressions are tangible, we call the surface rough; when they are infinitesimal, we call it smooth. If, now, this reasoning is correct, the surface of the head of a rail, as well as that of the circumferences of the wheels above it, are made up of elevations and depressions, which, when the two surfaces are in contact, must more or less fit into one another. And it is this fitting in of the minute elevations and depressions of the two surfaces that give rise to friction. If the two surfaces were absolutely smooth, there would be no friction, and, consequently, no tractive power in the locomotives, nor would the wheels under the cars turn around. Friction of this kind we are accustomed to call rolling friction. In reality, then, a rail and the wheel which rolls above it may be regarded as a rack and pinion with infinitesimal teeth, lacking, of course, the element of regularity as to the position of the teeth which characterizes a rack and pinion. So much for the surfaces involved in wear.

Now, what are the forces involved in wear, and what strains do they give rise to? If I understand the matter rightly, there are two kinds of friction which may occasion loss of metal by wear in the case of rails: 1st. Rolling friction, which occurs when the wheels turn round and the trains move forward; and 2d. Sliding friction, which occurs when the wheels turn around in the same place, as in the case of slipping drivers, or when the wheels do not turn around and yet move along the track, as in the case of sliding wheels. It is probable, however, that by far the largest portion of the loss of metal which rails suffer is due to rolling friction; it will, therefore, perhaps, be sufficient for our purpose to consider this case only.

The forces which act between the top of the head of the rail and the wheels in rolling friction may, it seems to me, be regarded as two in number. There is, first, a force acting directly downward, due to the weight of the locomotives and cars. This force may be regarded as a vertical force acting perpendicularly to head of the rail, and is in action both when the train is standing still and when it is in motion. Secondly, there is a force acting parallel to the head of the rail, due to the traction or impelling power of the locomotives. In the case of the driving wheels, this force may be supposed to act in the direction opposite to that of the motion of the trains. In the case of all the other wheels, this force may be supposed to act in the direction of the movement of the trains, and it is antagonism to this force by the rail that causes all these wheels to turn around. In the case of the drivers, the amount of this force acting parallel to the head of the rail is sufficient to overcome the total train resistance; in other words, to cause the train to move. In the case of the other wheels of the train, acting individually, this force parallel to the head of the rail is small, being only that necessary to cause the wheels to turn around; in other words, to overcome journal friction. The force parallel to the head of the rail acts only when the train is in motion.

In the case of rolling friction, there is, of course, no wear except when both these forces are acting at once. But when two forces are acting at the same time, their line of action must be regarded as in the direction of the resultant of the two forces. In the case we are considering we have a vertical force and a horizontal force acting at the same time, and the resultant line of action must, of course, be a diagonal. In other words, in rolling friction, if the conceptions given above are correct, the line of action of the force which produces wear must be regarded as a diagonal to the line formed by the head of the rail. In the case of the driving-wheels, the diagonal is inclined toward the front end of the train, and in the case of the other wheels it is inclined toward the rear of the train.

Returning for a moment to the conception previously mentioned, that the top of the head of the rail and the surface of the circumference of the wheel are a rack and pinion, with infinitesimal teeth, but without regularity in the teeth, let us see what kind of strain would be produced in these minute teeth by a force acting diagonally to the line of the head of the rail. I hardly see how we can avoid the conclusion that this strain would be a bending strain. In the case when the infinitesimal teeth of the wheel and rail did not fit into interstices, but struck against each other, in which case the ends of the teeth only would be involved in the strain, then surely the strain would be a bending one; and again, in the case in which the teeth mutually engaged each other as a rack and pinion, so long as there was motion of the train, which is a necessary condition of rolling friction, it seems to me that the strain would still be that of bending.

If we are right in regard to the nature of the surfaces involved in wear and the strains produced, wear is simply the breaking or pulling off of the infinitesimal teeth by the strains to which they are subjected. And here we see why it is that the softer rails give the better wear, for the harder the steel the more brittle it is; and the more brittle the steel the more readily will these infinitesimal teeth be broken off by the strains applied. On the other hand, the softer the steel the more readily will these infinitesimal teeth bend and flatten down under the strain without breaking off. Or, to make the statement general, if the nature of the steel is such that under the strains applied, whatever they may be, the teeth readily break off, which is characteristic of hard steel, the more rapid will be the wear; if, on the other hand, the nature of the steel is such that the teeth readily suffer distortion without rupture, bend and flatten down without breaking off, which is characteristic of soft steel, the slower will be the wear. The above is not offered as a complete solution of the

TABLE I.—COMPARATIVE DATA.

Service	No.	Time of service	Track	Degree of curve	Grade	WEIGHTS PER YARD. Original	Present	Loss	Tonnage	Loss per million tons	TORSION TESTS. Height of diagram	Length of diagram	Elastic limit	Area of diagram	TENSILE TESTS. Unannealed. Tensile strength	Elastic limit	Elongation	Annealed. Tensile strength	Elastic limit	Elongation	SHEARING TESTS. Shearing stress	Defrusion	BENDING TESTS. Maximum load	Deflection	CHEMICAL ANALYSES. Carbon	Phosphorus	Silicon	Manganese	Phosphorus units	Density
TANGENT, GRADE, AGAIN T TRAFFIC.	887	11	North.	....	89.76	66.79	64.66	2.13	55,197,994	.0386	2.78	18.13	0.95	41.85	69,000	34,000	25	67,000	28,000	24	49,000	.1000	2770	190°	.287	.048	.023	.435	24.2	.28143
	884	10	" "	....	95.04	68.73	66.60	2.13	52,174,969	.0408	3.03	14.73	1.03	36.37	75,000	36,000	24	74,000	33,000	22	55,000	.0875	3090	190°	.279	.082	.043	.656	32.7	.28214
	883	10	2	....	95.04	67.87	65.43	2.54	52,174,969	.0487	3.20	10.89	1.16	28.79	77,000	36,000	4	86,000	36,000	12	62,700	.0925	3090	190°	.352	.104	.029	.610	35.7	.28214
	885	11	" "	....	89.76	68.21	65.47	2.74	55,197,994	.0496	3.24	13.30	1.19	36.02	84,000	39,000	20	81,000	37,000	21	57,000	.0950	3110	190°	.368	.057	.130	.472	33.9	.28143
	891	7	1	South.	....	40.13	67.14	64.00	3.14	53,687,192	.0585	3.16	13.68	1.11	35.79	79,000	34,000	24	78,000	35,000	21	55,500	.1000	3140	70°	.305	.133	.022	.656	37.7	.28157
	888	11	"	North.	....	89.76	64.22	60.78	3.44	55,197,994	.0623	2.76	21.74	1.10	51.00	66,000	33,000	24	65,000	28,000	25	50,000	.1150	2670	190°	.208	.038	.074	.344	21.3	.28129
	892	7	1	South.	....	40.13	68.15	64.69	3.46	53,687,192	.0644	3.24	15.94	1.10	43.13	79,000	33,000	21	77,000	37,000	21	58,000	.0825	3230	72½°	.307	.114	.018	.542	33.7	.28229
	881	11	1	North.	....	92.40	69.03	65.18	3.85	55,546,811	.0693	4.00	10.95	1.54	37.75	108,000	56,000	15	98,000	52,000	18	68,500	.0950	4260	86°	.483	.035	.480	.782	57.2	.28143
	894	5	2	South.	....	52.80	67.47	64.54	2.93	38,088,574	.0769	3.55	8.46	1.37	25.96	93,000	45,000	5	82,000	44,000	6	70,000	.0650	3800	139°	.432	.118	.043	.889	45.9	.28086
	889	5	11	"	....	21.12	68.56	65.02	3.54	44,620,100	.0793	3.05	14.48	1.17	37.92	76,000	33,000	21	75,000	40,000	22	56,000	.0875	3030	137°	.298	.085	.067	.568	33.1	.28114
	895	5	2	"	....	52.80	67.92	64.89	3.03	38,088,572	.0796	3.39	5.47	1.48	15.42	60,000	30,000	1	56,000	40,000	1	64,500	.0675	3610	118½°	.470	.111	.063	.784	45.5	.28057
	896	5	2	"	....	52.80	68.46	65.42	3.04	38,088,572	.0798	3.61	12.05	1.76	36.79	93,000	40,000	20	89,000	40,000	17	63,000	.0800	3820	55°	.415	.097	.063	.694	40.5	.28200
	886	11	North.	....	89.76	65.72	61.24	4.48	55,197,994	.0811	3.04	12.29	1.11	30.84	78,000	34,000	19	75,000	28,000	19	55,000	.0900	2790	190°	.349	.069	.026	.404	27.9	.28243
	890	5	11	South.	....	21.12	69.79	66.15	3.64	44,620,100	.0816	3.37	12.65	1.20	36.77	85,000	36,000	21	83,000	36,000	19	60,500	.0750	3360	113°	.365	.126	.059	.702	41.7	.28100
	882	11	1	North.	....	92.40	68.36	62.58	5.78	55,546,811	.1040	2.99	14.68	1.03	36.57	76,000	34,000	21	73,000	30,000	23	53,500	.0925	2870	179°	.320	.060	.055	.442	28.1	.28143
	893	5	2	South.	....	21.12	68.45	64.39	4.06	38,088,572	.1066	3.37	12.92	1.14	37.15	89,000	38,000	17	86,000	39,000	11	61,500	.0825	3480	156°	.387	.091	.032	.893	41.1	.28214
TANGENT, GRADE, WITH TRAFFIC. LOW SIDE.	899	11	2	North.	5	21 12	64.18	61.94	2.24	52,370,617	.0428	2.72	18.32	1.01	41.68	68,000	30,000	25	65,000	28,000	26	51,000	.0925	2620	190°	.263	.051	.038	.326	22.3	.28214
	900	11	2	" "	5	21.12	64.46	62.02	2.24	52,370,617	.0466	3.16	11.19	1.16	29.96	84,000	34,000	17	82,000	32,000	16	59,500	.0875	3080	184½°	.428	.030	.059	.598	32.2	.28243
	901	7	11	" "	5	39 60	68 26	66.03	2.23	40,061,230	.0556	2.72	15.73	1.03	36.01	68,000	32,000	24	67,000	32,000	24	51,500	.1000	2490	190°	.233	.083	.027	.372	24.9	.28229
	906	10	10	" "	5	47.52	67.68	63 82	3.86	50,648,939	.0762	2.94	17.41	1.05	41.96	71,000	33,000	24	69,000	25,000	22	51,500	.0875	2870	190°	.308	.053	.057	.462	27.5	.28214
	910	8		South.	5	89.76	67.28	61.36	5.98	62,813,664	.0952	3.07	11.31	1.14	28.41	79,000	33,000	22	75,000	28,000	16	55,500	.0875	2660	190°	.343	.098	.020	.478	31.8	.28114
	904	2	11	"	5	39.60	67.85	65.63	2.22	21,504,824	.1032	3.06	13.07	1.03	33.11	79,000	33,000	16	77,000	34,000	16	56,000	.0875	2810	190°	.361	.100	.035	.552	34.7	.28100
	911	2	3	"	5	89.76	68.05	66.23	1.82	17,226,993	.1056	3.64	3.21	1.64	9.12	68,000	48,000	1	69,000	30,000	1	73,500	.0550	3760	140°	.618	.154	.039	1.044	58.8	.28143
	908	4	2	"	4	95.04	68.19	64.44	3.75	32,428,614	.1156	3.25	9.43	1.19	25.88	81,000	39,000	7	75,000	30,000	5	60,000	.0850	3350	175½°	.430	.158	.032	.552	42.7	.28129
CURVE, GRADE HIGH SIDE.	902	7	11	North.	5	39.60	67.12	62 25	4.87	40,061,230	.1215	3.01	13.04	1.00	32.13	79,000	38,000	8	76,000	28,000	14	57,500	.0925	2640	111°	.322	.077	.026	.492	29.5	.28214
	905	10	10	"	5	47.52	64.92	58 32	6.60	50,648,939	.1303	2.93	14.06	1.11	35.12	74,000	33,000	20	70,000	30,000	22	54,500	.0850	2710	174°	.342	.026	.044	.460	25.4	.28243
	909	4	2	South.	4	95.04	67.72	63.47	4.25	32,428,614	.1310	2.52	3.56	1.62	9.99	76,000	42,000	2	78,000	44,000	2	73,500	.0790	3420	50°	.600	.145	.041	.680	42.1	.28086
	898	11	2	North.	5	21.12	65.05	58.06	6.99	52,370,617	.1335	2.96	13.75	1.08	35.07	74,000	33,000	21	71,000	34,000	23	53,000	.0875	2670	170°	.358	.040	.028	.538	28.1	.28157
	897	11	2	"	5	21.12	64.49	57.18	7.31	52,370,617	.1396	3.24	11.65	1.25	32.43	82,000	36,000	18	80,000	32,000	17	59,500	.0800	2800	170°	.431	.049	.046	.582	33.2	.28186
	912	6		South.	5	95.04	68.29	59.78	8.51	47,438,145	.1794	3.45	11.74	1.31	33.98	91,000	38,000	10	88,000	50,000	12	61,500	.0750	3750	103°	.401	.083	.056	.816	40.8	.28157
	907	4	10	North.	5	47.52	65.71	59.72	5.99	24,211,147	.2474	3.53	13.04	1.33	38.82	90,000	40,000	21	86,000	44,000	20	62,000	.0850	3580	101°	.350	.102	.124	.748	43.1	.28200
	903	2	11	South.	5	39.60	68.28	61.39	6.89	21,504,824	.3204	2.57	7.36	1.04	16.10	71.0	0 34,000	9	69,000	24,000	12	55,500	.0975	2860	190°	.355	.108	.029	.490	33.8	.28114
LEVEL TANGENT.	917	6		North.	....	.....	67.14	66.94	0.20	31,127,829	.0064	3.59	11.86	1.45	36.34	93,000	42,000	19	89,000	45,000	18	65,000	.080	2930	13°	.423	.127	.083	.708	45.1	.28186
	919	10	6	North.	....	.....	55.61	55.10	0.51	51,720,011	.0098	2.72	17.22	1.07	39.20	64,000	32,000	24	62,000	30,000	25	51,500	.1025	2270	190°	.247	.041	.023	.344	20.3	.28243
	918	10	6	North.	....	.....	55.91	55.20	0.71	51,720,011	.0137	2.89	17.92	1.21	43.29	70,000	34,000	20	69,000	35,000	24	54,500	.095	2520	190°	.219	.061	.181	.376	29.0	.28200
	915	6	1	North.	....	.....	64.93	64.40	0.51	31,514,889	.0162	2.21	7.75	1.01	15.17	71,000	34,000	4	62,000	25,000	4	60,000	.0775	3030	184°	.368	.113	.026	.714	39.2	.28100
	926	9	3	South.	....	.....	64.96	63.43	1.53	76,409,123	.0200	3.05	16.97	1.22	42.56	73,000	40,000	26	71,000	36,000	24	55,500	.100	2680	190°	.211	.145	.033	.352	30.2	.28271
	913	9	4	North.	....	.....	65.52	64.51	1.01	45,855,101	.0220	3.13	12.18	1.16	32 20	72,000	39,000	7	76,000	35,000	18	58,000	.090	2630	190°	.335	.102	.036	.508	33.4	.28143
	927	9	3	South.	....	.....	64.98	63.25	1.73	76,409,123	.0226	3.07	19.01	1.55	48.91	72,000	40,000	26	71,000	35,000	24	58,500	.0975	2710	190°	.187	.131	.049	.320	28.1	.28214
	914	9	4	North.	....	.....	64.78	63.46	1.32	45,855,101	.0288	2.60	10.80	.97	23.28	64,000	32,000	14	64,000	30,000	17	52,000	.100	2530	190°	.270	.108	.015	.322	26.9	.28157
	928	5		South.	....	.....	66.25	64.93	1.32	43,610,150	.0303	2.98	3.37	1.32	8.29	60,000	44,000	1	68,000	50,000	2	66,000	.080	3190	173°	.428	.142	.042	.564	41 9	.28214
	920	11	7	North.	....	.....	67.61	65.78	1.83	52,991,684	.0345	2.95	18 27	1.00	43.99	69,000	32,000	25	68,000	25,000	24	53,500	.100	2630	190°	.293	.063	.039	.326	24.6	.28200
	924	4	1	South.	....	.....	68.31	66.79	1.52	36,349,989	.0418	3.67	12.64	1.37	39.71	93,000	39,000	20	90,000	36,000	18	66,000	.100	3550	111°	.388	.123	.059	.806	44.2	.28229
	916	6		North.	....	.....	67.25	65 83	1.42	31,127,829	.0456	3.18	10.67	1.25	28.47	83,000	39,000	17	81,000	40,000	18	60,500	.0875	3010	154½°	.329	.132	.044	.554	37.5	.28171
	925	4	1	South.	....	.....	68.36	66.63	1.73	36,349,989	.0476	3.70	14.95	1.36	47.58	92,000	40,000	13	90,000	40,000	18	66,500	.095	3980	73°	.389	.109	.069	.824	43.8	.28243
	922	5	4	North.	....	.....	69.04	67.01	2.03	27,622,230	.0735	3.74	12.57	1.37	39.97	94,000	39,000	19	91,000	35,000	17	66,500	.090	3760	80°	.428	.109	.038	.870	44.7	.28243
	923	6	1	North.	....	.....	68.58	65.66	2.92	31,514,889	.0926	2.21	4.55	1.08	10.59	64,000	34,000	3	54,000	34,000	2	64,500	.085	3360	155°	.452	.144	.037	.708	45.5	.27943
	921	5	4	North.	....	.....	67.23	64.18	3.05	27,622,230	.1104	3.34	11.68	1.20	33.19	84,000	37,000	18	82,000	35,000	16	65,000	.090	3310	172°	.340	.096	.042	.746	37.9	.28257
CURVE. LOW SIDE.	932	10	6	North.	3	.....	56.17	54.95	1.22	51,720,011	.0236	2.92	16.53	1.09	39.40	69,000	34,000	20	70,000	35,000	23	57,000	.100	2340	190°	.269	.047	.026	.372	22.4	.28286
	937	3	4	South.	2	.....	66.77	65.96	0.81	29,905,122	.0271	3.00	4.84	1.34	12.12	68,000	38,000	2	68,000	36,000	3	68,500	.085	3220	168°	.454	.145	.015	.726	44.8	.28129
	936	12	9	South.	2	.....	68.02	65.17	2.85	92,025,478	.0309	3.01	15.56	1.05	38.72	72,000	34,000	23	70,000	26,000	22	53,500	.1025	2790	190°	.353	.039	.035	.318	23.8	.28259
	930	11	7	North.	2¼	.....	66.38	64.65	1.73	52,991,684	.0327	3.03	14.77	1.04	36.94	73,000	31,000	23	70,000	25,000	22	53,500	.1000	2820	190°	.394	.035	.038	.288	24.3	.28286
	934	9	8	South.	3½	.....	67.14	64.09	3.05	78,364,968	.0389	2.95	13.89	1.26	34.43	74,000	39,000	22	74,000	35,000	22	61,000	.1025	2950	190°	.187	.144	.045	.252	27.8	.28214
	943	6	3	South.	2	.....	66.84	64.30	2.54	55,127,464	.0461	3.04	16.05	1.10	41.08	74,000	34,000	24	70,000	38,000	24	55,500	.100	2780	159½°	.314	.061	.025	.602	29.8	.28214
	939	4	2	South.	4	.....	68.11	65.27	2.84	37,150,179	.0764	3.76	7.63	1.47	24.51	90,000	40,000	8	95,000	41,000	6	72,000	.090	3350	20°	.579	.115	.036	.718	47.0	.28171
	942	4	10	South.	3	.....	67.93	62 67	5.26	42,277,638	.1244	3.52	5.38	1.60	15.48	90,000	48,000	2	64,000	40,000	1	64,500	.0575	3240	108¾°	.497	.136	.062	.724	47.8	.28143
LEVEL. HIGH SIDE.	935	12	9	South.	2	.....	68.19	64.93	3.26	92,025,478	.0354	3.30	11.80	1.14	32.70	86,000	39,000	10	82,000	30,000	20	64,000	.095	3130	142½°	.460	.045	.059	.406	30.2	.28259
	929	11	7	North.	2¼	.....	68.89	66.45	2.44	52,991,684	.0460	2.89	16.28	1.18	39.95	69,000	36,000	24	70,000	35,000	24	55,500	.1125	2750	190°	.235	.055	.080	.300	23.3	.28259
	933	9	8	South.	3½	.....	67.61	63.15	4.46	78,364,968	.0569	3.16	8.19	1.20	21.91	82,000	38,000	5	67,000	35,000	3	65,000	.085	3180	186°	.376	.087	.054	.558	35.1	.28143
	944	6	3	South.	2	.....	66.72	63.47	3.25	55,127,464	.0589	3.00	6.78	1.24	16.68	75,000	34,000	4	78,000	33,000	8	61,500	.095	3040	105°	.441	.057	.035	.702	36.1	.28214
	931	10	6	North.	3	.....	57.09	52.61	4.48	51,720,011	.0866	2.81	17.70	1.10	42.24	66,000	34,000	24	64,000	27,000	24	52,000	.110	2430	150°	.260	.047	.029	.416	23.1	.28229
	938	3	4	South.	2	.....	68.70	64.85	3.85	29,905,122	.1287	3.06	12.16	1.02	29.53	79,000	36,000	16	77,000	35,000	16	59,500	.0925	2950	146°	.343	.115	.035	.594	37.5	.28143
	941	4	10	South.	3	.....	66.92	60.83	6.09	42,277,638	.1440	3.43	13.88	1.25	40.30	87,000	39,000	19	83,000	37,000	16	63,500	.095	3290	112°	.404	.111	.065	.716	42.1	.28186
	940	4	2	South.	4	.....	68.17	61.77	6.40	37,150,179	.1723	3.80	5.38	1.62	16.73	76,000	52,000	1	80,000	44,000	2	77,500	.0725	3220	17¾°	.548	.127	.040	.680	46.9	.28214

TABLE NO. II.—AVERAGES.

Number of line	Number of rails in average	DESCRIPTION OF AVERAGES	Loss per million tons	Grade	Degree of curve	TORSION TESTS. Height of diagram	Length of diagram	Elastic limit	Area of diagram	TENSILE TESTS. Unannealed. Tensile strength	Elastic limit	Elongation	Annealed. Tensile strength	Elastic limit	Elongation	SHEARING TESTS. Shearing stress	Defrusion	BENDING TESTS. Maximum load	Deflection	CHEMICAL ANALYSES. Carbon	Phosphorus	Silicon	Manganese	Phosphorus units	DENSITY.
1	8	Grade tangent, slower wearing	.0540	70.00	.....	3.18	14.92	1.15	38.84	79,625	37,625	19.6	78,250	35,750	20.5	56,962	.0959	3014	147°	.324	.076	.102	.562	34.8	.28184
2	8	Grade tangent, faster wearing	.0861	50.49	.....	3.29	11.62	1.28	32.15	81,250	36,625	15.6	77,375	37,125	14.7	60,500	.0800	3320	133°	.379	.095	.051	.669	37.9	.28141
3	4	Grade curve, low side, slower wearing	.0553	32.34	5°	2.80	15.66	1.06	37.40	72,750	32,250	22.5	70,750	29,250	22.	53,375	.0919	2765	188°	.308	.054	.045	.439	26.7	.28225
4	4	Grade curve, low side, faster wearing	.1049	78.54	4¾°	6.25	9.25	1.25	24.13	76,750	38,250	11.5	74,000	30,500	9.5	61,250	.0787	3145	174°	.438	.127	.031	.656	42.0	.28121
5	4	Grade curve, high side, slower wearing	.1291	50.82	4¾°	2.85	11.10	1.20	28.08	75,750	36,500	12.8	73,750	34,000	15.2	59,625	.0837	2860	126°	.405	.072	.035	.542	31.3	.28175
6	4	Grade curve, high side, faster wearing	.2217	50.82	5°	3.20	10.95	1.23	30.33	83,500	37,000	14.5	80,750	40,000	15.2	59,625	.0844	3247	141°	.384	.085	.064	.659	37.7	.28164
7	8	Level tangent, slower wearing	.0174	.....	.....	2.91	14.22	1.20	35.12	72,375	36,625	17.5	70,500	33,875	19.2	56,875	.0928	2662	167°	.282	.104	.056	.455	31.6	.28189
8	8	Level tangent, faster wearing	.0595	.....	.....	3.22	11.09	1.24	31.47	79,875	38,000	14 5	78,000	36,875	14.4	63,562	.0906	3349	128°	.381	.115	.046	.675	40.0	.28187
9	4	Level curve, low side, slower wearing	.0286	.....	2 5-16°	2.99	12.92	1.13	31.79	70,500	34,250	17.	69,500	30,500	17.5	58,125	.0969	2792	184°	.367	.066	.028	.426	28.8	.28240
10	4	Level curve, low side, faster wearing	.0715	.....	3⅞°	3.32	10.74	1.36	28.87	82,000	40,250	12.7	76,000	38,500	13.2	63,250	.0875	3080	119°	.394	.114	.042	.574	38.1	.28185
11	4	Level curve, high side, slower wearing	.0493	.....	27-16°	3.09	10.76	1.19	27.81	78,000	36,750	10.7	74,250	33,250	13.7	61,500	.0969	3025	150°	.378	.061	.057	.491	31.2	.28219
12	4	Level curve, high side, faster wearing	.1329	.....	3°	3.28	12.28	1.25	32.26	77,000	40,250	15.	76,000	35,750	14.5	63,125	.0925	2978	116°	.388	.100	.044	.601	37.4	.28193
13	24	Tangents and low sides curves, slower wearing	.0378	.....	.....	3.01	14.48	1.15	36.19	74,542	35,833	18.9	72,958	33,167	19.8	56,529	.0943	2818	167°	.314	.080	.065	.483	31.4	.28201
14	24	Tangents and low sides curves, faster wearing	.0779	.....	.....	3 27	10.90	1.28	30.04	80,167	37,958	14.1	76,792	36,167	13.5	62,104	.0847	3260	140°	.392	.110	.044	.646	30.3	.28160
15	8	High sides of curves, slower wearing	.0892	.....	.....	2.97	10.93	1.19	27.14	76,875	36,625	11.7	74,000	33,625	14.4	60,562	.0903	2942	138°	.391	.066	.046	.516	31.2	.28197
16	8	High sides of curves, faster wearing	.1773	.....	.....	3.24	11.61	1.24	31.27	80,250	38,625	14.7	78,375	37,875	14.8	61,375	.0884	3109	128°	.386	.092	.054	.630	37.5	.28178
17	32	All conditions, slower wearing	.0506	.....	.....	3.10	13.59	1.16	34.13	75,125	36,031	17.1	73,219	33,281	18.5	57,537	.0933	2878	160°	.334	.077	.060	.491	31.3	.28201
18	32	All conditions, faster wearing	.1028	.....	.....	3.26	11.08	1.27	30.35	80,188	38,125	14.2	77,188	36,594	13.8	61,922	.0856	3222	133°	.390	.106	.047	.647	38.9	.28165

problem of wear, but as possibly helping us to understand why it is that the softer rails give the better wear as we actually find they do.

The data which have been obtained in the work done on this series of rails, make it possible to get at some very interesting results as to the rate of wear of rails under different conditions of service. Thus, for example, what is the comparative rate of wear of rails on grade tangents and on level tangents, or on grade curves and on level curves, or on curves as compared with tangents, etc.? These comparisons may be made by taking the average loss of metal per million tons of all the rails which did their service under any one set of conditions, and comparing it with the average loss of metal of all the rails which did their service under any other set of conditions. This, of course, involves the supposition that the sixteen rails, for example, which did their service on grade tangents, were equally as good, taken as a whole, as the sixteen which did their service on level tangents. Whether this supposition is absolutely true or not, I think the differences between groups of rails, that is the differences between the groups that did their service under different conditions, can hardly be great enough to lead us into serious error. The results of these comparisons is given in the following three tables. In these tables the first column denotes the kind of service to which the rails have been subjected, the second column denotes the number of rails from which the average loss of metal per million tons in column third is derived, and the fourth column denotes the ratio of the loss of metal for the kind of service between which the comparison is made.

TABLE NO. III.

Effect of Grade on Wear.

Kind of service:	No. of rails.	Av. loss of metal	Ratio.
Level tangent	16	.0384	1:1.82
Grade tangent	16	.0701	
Level curve	16	.0706	1:1.80
Grade curve	16	.1277	
Levels	32	.0545	1:1.81
Grades	32	.0989	

The above table shows the effect of grade on the wear of rails. The average grade for the rails on tangents was 64.75 ft. to the mile, and, as will be observed, the rails on the grades lost 1.82 times as much metal as the rails on levels. The average grade for the rails on curves was 53.13 ft. to the mile, and, as will be observed, the rails on the grades lost 1.80 times as much metal as the rails on levels. The average grade for the whole 32 rails which were on grades was 58.94 ft. to the mile, and, as will be observed, the ratio of the loss of metal on levels and grades is as 1 : 1.81. This table may be roughly summed up by saying that within the limits of our experiments, and with a grade of not quite 60 ft. to the mile, the rails on the grade lose about 80 per cent. more metal per million tons than the rails on levels.

TABLE NO. IV.

Effect of Curves on Wear.

Kind of service:	No. of rails.	Av. loss of metal.	Ratio.
Grade tangents	16	.0701	1:1.82
Grade curves	16	.1277	
Level tangents	16	.0384	1:1.84
Level curves	16	.0706	
Tangents	32	.0542	1:1.83
Curves	32	.0992	

The above table shows the effect of curves on the the wear

of rails. The average degree of curvature of the rails on grades was 4⅛°, and, as will be observed, the rails on the curves lost 82 per cent. more metal per million tons than the rails on tangents. The average degree of curvatures on levels was 2$\frac{23}{32}$°, and as will be observed, the rails on curves lost 84 per cent. more metal than the rails on tangents. The average degree of curvature for the whole 32 rails on curves was 3$\frac{31}{64}$°, and, as will be observed, the rails on curves lost 83 per cent. more metal than the rails on tangents. This table may be roughly summed up by saying that under the conditions of our experiments, and on about 4° curves, the rails on the curves lose about 83 per cent. more metal per million tons, than the rails on tangents.

TABLE NO. V.

Wear on High and Low Sides of Curves.

Kind of service:	No. of rails.	Av. loss of metal	Ratio.
Grade curve, low side...	8	0.0801	1:2.19
Grade curve, high side..	8	0.1754	
Level curve, low side....	8	0 0500	1:1.82
Level curve, high side....	8	0.0911	
Low sides.....	16	0.0650	1:2.05
High sides.....	16	0.1332	

The above table shows the relative rate of wear on the high and low sides of curves. The average degree of curvature of the rails on the grades was 4⅛°, and the average elevation of the rails on the high sides of the curves was 4⅛ ins., and, as will be observed, the rails on the high sides of the curves lost 2.19 times as much metal per million tons as the rails on the low sides of the same curves. Again, the average degree of curvature of the rails on the levels was 2$\frac{23}{32}$°, and the average elevation of the outer rail was 2$\frac{23}{32}$ in., and, as will be observed, the rails on the high sides of the curves lost 82 per cent. more metal than the rails on the low sides of the same curves. Finally, the average curvature of all the rails on curves was 3$\frac{31}{64}$°, and the average elevation of the outer rail was 3$\frac{31}{64}$ in., and, as will be observed, the rails on the high sides of the curves lost 2.05 times as much metal as the rails on the low sides of the same curves. This table may be roughly summed up by saying that, under the conditions of our experiments, with an average curvature of about 4°, and an average elevation of the outer rail of about 4 in. the rails on the high sides of the curves wear a little over twice as fast as the rails on the low sides of the same curves.

The data which have been obtained in the work done in this series of rails furnish likewise the means of getting at some interesting facts as to the life of rails. It is of course a difficult thing to say just exactly when a rail is so worn that it can fairly be called worn out. And yet we can perhaps make a few assumptions which, although not absolutely definite, may aid in throwing some light on this interesting question. If we take any standard 67 lb. rail, and suppose that the head is worn off on tangents or on the low sides of curves until it is from ¼ to ⅜ of an inch lower than it was when rolled, the amount of metal worn off will vary from about 6 lbs. to 10 lbs. per yard. On the other hand, if the rail has done service on the high sides of curves, the amount of metal worn off when the side of the head is worn up to the fish-plate will not be far from 7 lbs. per yard. But as I understand it, the present practice on the road is, when a rail has become worn on the high side of a curve up to the fish-plate, to remove it to the other side of the curve, and get two or three years more wear out of it in that position. For the very general conclusions that we are after, therefore, it will perhaps be sufficiently accurate to say that a rail may fairly be said to be worn out when it has lost 8 lbs. of metal per yard. This assumption of course does not pretend to actually represent the loss of metal by wear which may or ought to be obtained from every rail before it is worn out. In the case of the old standard section, it is probable that rails may fairly be said to be worn out when they have lost in the neighborhood of 8 lbs. per yard. In the case of the new standard section (section of 1875) a loss of from 10 to 14 lbs. per yard would leave the rail in as good condition as a loss of 8 lbs. per yard from the old standard section. In the following data, however, a rail is assumed to be worn out when it has lost 8 lbs. per yard, and from the figures given it will be easy to obtain the life of rails for any other assumed loss of metal. It will, of course, be borne in mind that the figures which follow are strictly applicable only to rails of the same quality and doing service under the same conditions as those from which these figures are derived. The conclusions must therefore be regarded as entirely general.

The following table shows what, with such average quality of steel as this report deals with, may be expected from rails in the various conditions of service. The first column gives the number of the line in the table, the second column the kind of service, the third column the number of rails from which the average loss of metal in column four is obtained, the fifth column the number of million tons required in order that the rail may lose 8 lbs. of metal per yard, the sixth column the life, or number of years the rail would last in the north track, and the seventh column the life, or number of years in south track. These last two columns are computed on the supposition that the yearly tonnage on the north track is 5,000,000 tons and on the south track 8,000,000 tons. On the north track, during the 9½ years previous to July 1879, the average annual tonnage, including of course the locomotives and the weight of the cars as well as their loads, has been 4,904,000 tons, while on the south track, during the six years previous to July 1879, the average annual tonnage has been 7,985,000 tons.

TABLE NO. VI.

The Life of Rails Under Different Conditions of Service.

No. of line.	Kind of service.	No. of rails.	Average loss of metal.	No. of million tons to lose 8 lbs.	Life in years, north track.	Life in years, south track.
1	Level tangents	16	.0384	208.4	41.7	26.1
2	Grade tangents	16	.0701	114.1	22.8	14.2
3	Level curves	16	.0706	113.3	22.6	14.1
4	Grade curves	16	.1277	62.7	12.5	7.8
5	Low side level curves	8	.0500	160.0	32.0	20.0
6	High side level curves	8	.0911	87.8	17.5	11.0
7	Low side grade curves	8	.0801	98.9	19.8	12.3
8	High side grade curves	8	.1754	45 7	9.1	5.7
9	Tangents	32	.0542	147.6	29.5	18.5
10	Curves	32	.0992	80.6	16.1	10.1
11	Levels	32	.0545	146.8	29.4	18.3
12	Grades	32	.0989	80.9	16.2	10.2
13	Low side curves	16	.0650	123.1	24.6	15.4
14	High side curves	16	.1332	60.1	12.0	7.5
15	All conditions	64	.0767	104.3	20.8	13.0
16	32 slower wearing	32	.0506	158.1	31.6	19.8
17	32 faster wearing	32	.1028	77.8	15.6	9.7

In the above table the first eight lines show what may be expected from rails of the quality we are considering in all the conditions of service, on the supposition that a rail is worn out when it has lost eight pounds of metal per yard, and that it carries five million tons per year in the north track and eight million tons per year in the south track. It is, of course, very simple to obtain from the figures given the life of rails under any other supposition. Thus, if the tonnage doubles, the life of the rails would of course be one-half as great as that given above. On the other hand, if a rail is not regarded as worn out until it has lost twelve pounds of metal per yard, the life of the rail, the tonnage being the same, will be one-half greater than the figures given above. The remaining lines of this table, except the last two, show the life of rails under different combinations of the various conditions of service. They are given for the sake of information, and perhaps do not need any special comment or explanation. The first eight lines, of course, give the data that are most valuable. With regard to these data it will be noticed that on the high sides of grade curves, the average degree of curvature being 4⅛° and the average grade 64.75 ft. to the mile, a rail of such average quality as those we are studying, and on the suppositions above given as to loss of metal and tonnage, may be expected to last a little less than six years in south track and a little over nine years in north track. On the low sides of the same curves the life is a little more than twice as long. This table may, perhaps, be best summed up by saying that rails have their shortest life on the high sides of grade curves, next on the high sides of level curves, next on the low sides of grade curves, next on grade tangents, next on low sides of level curves, and their longest life, as would be expected, on level tangents.

It is an interesting question whether it will be possible to get the high number of years' service given under some of the conditions above in actual practice? At first sight this seems improbable. But so far as loss of metal by wear is concerned, I see no escape from the conclusions given above, the conditions remaining the same. Other causes may, of course, take a rail out of service. And undoubtedly these other causes, such as crushing, breaking, distortion of head, and especially uneven wear, will all combine to make the average life considerably less than the above figures show. Nevertheless, the life of rails due to wear alone being known, it will, of course, be the aim to diminish the removal of rails from the track due to other causes as much as possible, and thus approximate closely to the best results.

One word more in regard to the life of rails. The last two lines in the above table give the same items of information, computed in the same way, as are contained in the remainder of the table. But in the first of these two lines the data are such as would be obtained if all the rails in the series had been as good as the average of the 32 slower-wearing or better rails, while the second of these two lines shows what would result if all the rails had been the same as the average of the 32 faster-wearing. As will be observed, if all the rails in the series had lost metal or worn as fast as the average of the 32 faster-wearing rails, the best that we could expect under the suppositions given, as to loss of metal and yearly tonnage, would be a tonnage of about seventy-eight millions and a life of a little less than ten years in south track. On the other hand, if all the rails had been as good as the average of the 32 slower-wearing or better rails, the tonnage and life would be just about double these figures. In other words, the slower-wearing rails are on the average about twice as good in quality as the faster-wearing, and would consequently give about twice as high a tonnage and twice as long a life.

These data may be put in another form, which perhaps will be the fairer way of looking at them: The average life of the 64 rails we are studying, on the supposition that they are worn out when they have lost eight pounds per yard, and that the yearly tonnage in south track is eight million tons, is, as is seen in third line from bottom of above table, thirteen years. If, now, we were able to obtain steel rails as good in average quality as the 32 slower-wearing rails in our series, this average life would be almost twenty years, or an increase in life of over 50 per cent.

The question now arises: How shall the results of this work be utilized? I think it is entirely evident that the direction in which effort must tend in order that these results may be utilized is toward securing softer steel. And just here, perhaps, is the proper place to notice what seems to me a very important point. As you know so well this is our second investigation upon steel rails. The first investigation, as has already been stated, dealt principally with the question as to the relation between the chemical and physical properties of steel rails, and their power to resist crushing and fracture in track. The conclusion reached, as you remember, was that the softer rails are less liable to crush or break in service than the harder ones. Now, in this second investigation we find that the softer rails give the better wear. In other words, the softer steel makes rails which are not only less likely to crush or break in service, that is, rails that insure greater safety in the track, but also the softer steel makes rails that give better wear. And, unless the conclusions upon these two points can be overthrown by an equal amount of work, as carefully and conscientiously done, I do not see how the Pennsylvania Railroad can, in the future, do otherwise than use every effort to secure softer steel in its rails. And for this purpose I can see nothing better than that for the future the rails shall be bought on specifications, and subject to inspection and test before they are accepted. What specifications, therefore, does it seem wise to propose?

1st. As to chemical composition: It seems to me that it would be entirely philosophic to take as the specifications for the chemical composition the average analysis of the 32 slower-wearing rails in the series we are studying; especially as this analysis confirms the work done on the 25 samples of steel rails in the first report to you on this subject. This average analysis is as follows:

Carbon	0.334 per cent.
Phosphorus	0.077 "
Silicon	0.060 "
Manganese	0.491 "

But, as was stated in that report, the amount of phosphorus above given is rather lower than the manufacturers of steel rails in this country can comfortably work. It would perhaps, therefore, be wise to increase the amount of phosphorus a little and diminish some of the other hardeners proportionally. In view of this reasoning, therefore, I see nothing better than to re-recommend the specifications as to chemical composition in our first report, as follows:

Phosphorus, not above	0.10 per cent.
Silicon, not above	0.04 "
Carbon, between 0.25 per cent. and 0.35 per cent., with an aim at	0.30 "
Manganese, between 0.30 per cent. and 0.40 per cent., with an aim at	0.35 "
Sulphur and copper	No specifications.

2d. As to physical tests and inspection. What physical tests and inspection shall the Pennsylvania Railroad prescribe for its rails? The inspection which is now practiced seems abundant to exclude rails whose defects are evident to the eye. As to the quality of the steel something further seems to be needed. Now, a physical test to determine the quality of the steel must, in the first place, be of such a nature that it will protect the consumer; that is, enable him to reject such steel as is not fitted for the purpose for which it is designed to use the metal. In the second place it must be practicable; that is, it must not require too elaborate appliances nor too much labor to make the test; and finally, it must not be so severe on the manufacturers as to cause unnecessary hardship and loss in manufacturing the metal. What physical test now will fill these requirements? The data which have been obtained in the work done on the rails we have been studying enable us to prepare specifications which will make it possible to use any one of these four kinds of tests, viz., torsion test, tensile test, shearing test, or bending test. Thus we could, and if so desired will, prepare specifications, leaving it optional with the steel-rail manufacturers which test shall be used. And I may be permitted to say here that, if the torsion test is chosen, the data of the slower-wearing rails so strongly confirm the position taken in the first report to you on this subject that I do not see how anything else could be done than to re-recommend the specifications of the torsion test in that report.

But, in looking over the physical tests of this series, I think it is plainly evident that the shearing tests and the bending tests bear a closer relation to the loss of metal per million tons than any of the other tests. It is true that there are some anomalous cases even in these tests: some cases that do not exactly fall into line. In the case of the bending tests this may in part, perhaps be accounted for by the fact that these tests were made on samples cut from the web of the rail instead of from the head, where the wear took place. Mr. Cloud has found by a series of companion tests, made from samples cut from the head and web of the same rails, that the physical qualities of the metal in the head differ somewhat from that in the web, and, as has just been said, this may to a certain extent explain some of the anomalous cases in the series of bending tests. This closer agreement, however, between wear and the physical qualities of metals which are measured by shearing and bending, suggests that perhaps a shearing or bending test would be the best one to apply. And here I would like to express my judgment that the test suggested by Mr. J. T. Smith, General Manager of the Barrow Hematite Steel Works, several years ago, is, all things considered, the best physical test ever proposed for the examination of steel rails. Mr. Smith proposed that the fish-plate holes should be punched by a registering press, and that the quality of the steel should be judged by the pressure required to punch these holes. With the proper specifications as to the upper and lower limit of the punching strain, both steel that was too hard and steel that was worthless, from being spoiled in manufacture, could be rejected. And, still further, this punching test would be a shearing strain, and at the same time would enable a judgment to be formed of the quality of the steel in every rail. A slight reaming of the holes after they were punched would remove the ring of metal injuriously affected by the punch, and leave the rails uninjured as to strength at the fish-plate holes. Unfortunately, however, with present appliances the punching test seems to be impracticable.

It would, perhaps, therefore be the best to apply a bending test, especially if our analysis of the strain applied to the infinitesimal teeth of the rail in rolling friction is a correct one. It will be remembered that the theoretical considerations of what takes place in wear seem to plainly indicate that the strain applied to the minute elevations on the rail is a bending strain. If this is true, there could be no better test of the quality of steel to resist wear than a bending test.

Now, there are four ways in which a bending test could be applied:

1st. The drop test. This test is in good use in England at the present time to determine the quality of steel for rails. But the disposition in this country, so far as my knowledge goes, seems to be to regard it as a somewhat crude test, and it is, therefore, being laid aside in favor of more accurate modes of testing.

2d. A piece of steel hammered out from a crop-end could be bent under a steam-hammer. This test was in use on the Pennsylvania Railroad for some time to determine the quality of the steel, but its crudity, and the fact that the metal was manipulated after it had been rolled, and thus did not represent the steel in the rails, seem to me very justly to have led to its abandonment.

3d. A crop-end or piece of the rail just as it was rolled may be bent in a testing-machine. With proper specifications this test will undoubtedly give entirely satisfactory results. With a proper upper limit as to the maximum load required to bend the rail, steel that was too hard could be rejected, and, with proper specifications as to the amount of deflection the steel should stand before rupture, steel that was worthless from being spoiled in manufacture could likewise be rejected, and thus only good material be received. We would be glad to prepare specifications for this test if desired.

4th. A test-piece cut from the rail could be bent in the testing-machine. This test would undoubtedly likewise give us entirely satisfactory results. And for this test we have the data already at hand from which to prepare specifications. One or two things, however, should be borne in mind: 1st. The tendency of the steel rail manufacturers in this country at the present time to make steel much harder than is desirable, if our conclusions as to the wearing quality of steel are correct. This tendency must, of course, be recognized in preparing the specifications. And, in my judgment, this tendency will best be met by assigning an upper limit to the maximum load in the bending test. 2d. While our desire is to secure softer steel for rails, it must be remembered that steel may be so manipulated in manufacture as to render it very inferior in quality. Our specifications must, therefore, enable us to reject such worthless steel. This, in my judgment, will be successfully accomplished by requiring the test-pieces to bend to a certain angle before rupture.

I would, therefore, recommend that on all steel for rails received by the Pennsylvania Railroad Company in future the following bending test be prescribed: The test-pieces shall be cut from the web of the rail and shall be 12 in. long, 1½ in. wide and ½ in. thick. These pieces shall be tested in the manner prescribed in the preceding part of this report, and on all steel accepted these test-pieces shall stand a maximum load of not over 3,000 lbs., and shall bend not less than 130° without rupture.

It gives me pleasure to make acknowledgments for services rendered to those who have assisted in this investigation. Mr. J. W. Cloud, Engineer of Tests, has had charge of the physical tests and measurements, and has either made them himself or had them made under his supervision. He has also, from time to time, made suggestions and contributed to the development of the ideas that have been worked out during the investigation in so many instances that it would be difficult to enumerate them. Mr. A. O. Dayton, Assistant Engineer of Tests, made all the measurements with the planimeter, and likewise assisted in making the physical tests. Mr. H. L. Wells, at present Chemist of the Colorado Iron and Coal Company, Pueblo, Col., did quite a portion of the chemical work. The phosphorus and manganese were principally determined by him. The silicon was determined by Mr. Wells and myself working together. The carbon was determined by myself. The services of my assistant, Mr. Theo. J. Lewis, have been almost invaluable in every part of the investigation. His patience, industry and careful attention to details can only be appreciated by those who know how laborious has been the work of collecting and working out into its present form the information herewith presented.

Very truly yours, CHARLES B. DUDLEY, Chemist.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts made payable to* THE RAILROAD GAZETTE. *Communications for the attention of the Editors should be addressed* EDITOR RAILROAD GAZETTE.

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published*

THE APPOINTMENT OF LOCOMOTIVE ENGINEERS.

It is not an easy matter to determine, without an actual trial, whether a man has the necessary qualifications to run a locomotive. It is difficult even to enumerate all of them. We know that while he is running a locomotive he must at all times be vigilant to discern danger, and know that his engine is in good working order. He should be prudent and always take the safest course when there is more than one to choose from, but at the same time be capable of acting with the utmost courage and self-sacrifice in some emergencies. His duties require him to have a thorough knowledge of the construction and operation of the machine he has charge of. To achieve the best results he requires what may be called an economical turn of mind, that is, he must understand the conditions under which the engine is working and assign to its various functions their true value, so that he can combine them in such a way that they will perform the maximum service. To know that his engine is in good order he must be a careful, patient sort of person, who will examine it thoroughly and at the same time be alert and quick to discern defects. Perhaps more than almost anything else, he must be loyal to his superior officers, and always obey orders implicitly, and yet, at times, act with what may appear to be the most reckless decisiveness. To obey orders faithfully, he of course must know what they are, and for this he must have more or less of a kind of docility or willingness to acquire knowledge which has no other claim for consideration than the fact that it is taught by superior authority. Good eyesight, both for distance and for color, is absolutely needed. A knowledge of reading, writing and arithmetic is also requisite. An acquaintance with the ordinary physical laws and of the principles of the construction and working of a locomotive is demanded. On some smaller roads, where those who run locomotives are obliged to do some of their own repairs, more or less skill in such work is absolutely necessary, also a knowledge of how to act in certain emergencies when the machinery fails, and how to take care of persons if wounded in an accident.

Last week we called attention to the fact that it is now generally the practice on the principal roads to promote engineers from firemen, and for that reason, on some roads, special orders have been taken to select the candidates for firemen from the "right stock." We also took occasion to point out that if this is arrived at, it is desirable that the candidate should be well born, that is, be descended from decent honest and industrious parents, and he should have good health and physique, perfect eye-sight, and know how to read, write and cipher. His moral character should receive some consideration. One test of this was the regard of the person for pecuniary obligations. That is, does he pay his debts? It was also recommended that some weight should be given to the character which the candidate made for himself at school, or in the places where he was previously employed.

Supposing then that some care has been taken to select "right stock" for firemen, the question comes up, as the correspondent whose letter we published last week remarked, what system or method should be adopted for the promotion of these firemen to engineers?

On many roads firemen are promoted simply by a seniority of service. This, of course, does not always result in the selection of the best men. Nevertheless, it is plain that the person who has served faithfully for the longest time has some claim to promotion, unless there are some palpable reasons why he should not have it. The true and just principle seems to be that length of service should entitle a man to *a chance* for promotion, but that he should be compelled to show his fitness for it by some other test. What should that test be? On many roads a system of oral examination has been employed. Notwithstanding its apparent justice and effectiveness, we confess to much doubt of its adequacy for the purpose for which it is employed. To quote from Sir. Arthur Helps' "Thoughts on Government:" "There are certain primary requisites, the existence of which may be perfectly ascertained by examination. For example, there are qualifications of the most elementary kind in reading, writing and arithmetic, which may well be insisted upon." It also will reveal whether a candidate for promotion has the requisite knowledge of physical laws and the principles of the construction and operation of engines, which he should have, although great care should be taken in examining a candidate that mere inability to express himself be not mistaken for ignorance of facts and principles. As Helps says: "Examination detects qualifications which are little needed, while it fails, inevitably, to discover those which are most needed. * * * * A humorous person I know is wont to say: 'If you were to try the candidates in whist, there might be a chance of discerning whether they would be capable of dealing with the real business of the world.'"

The following incident will be an illustration of this. On one of the principal roads leading to New York, an old and experienced locomotive engineer was running a fast and heavy passenger train. While at full speed, he saw that there was something wrong with a freight car in an approaching train on the other track. Before he reached it the car had run square across the track on which he was running. It was too late to stop, so with perhaps reprehensible profanity but commendable courage he remarked, "Damn that car; I'll cut it in two," and opened the throttle wide, threw the reverse lever forward, and actually did what he said he would, with no other injury to his train than to smash the front end and cab of the engine, and injure slightly one or two of the baggage cars. Not a wheel of his train was off the track, and no one was injured. Now what kind of examination would reveal whether a man had that kind of courage? It may be said, though, what else than the actual circumstances of such an emergency would? which is a pertinent remark, but to quote the opening sentence of our article of last week: "An unfailing test which will determine a man's character and capabilities with unerring precision has never yet been discovered." The significance of these considerations, though, and the aspect of the subject to which we want to direct attention, as was said before, are the inadequacy of oral examination in determining a person's fitness for the responsible duties of a locomotive runner. It is not advised that candidates for promotion should not be subjected to such examination, because, to repeat a quotation again, "there are certain primary requisites, the existence of which may be perfectly ascertained by examination." What is insisted upon here is, that those which are of the most vital importance it will not detect.

There is, however, one great advantage in selecting firemen and promoting engineers by examination. That is, that it places it in the power of the authorities to choose only men with a fair amount of education and intelligence. Few railroad officers, and probably none of their engineers, have put the question of strikes and trades-unions entirely out of their minds. It would be the utmost blindness to suppose that contests between employers and employés concerning wages, and other questions, will not occur again. If they do, a mass of ignorant men is much more difficult to satisfy with just dealing than intelligent ones are, and, as has been pointed out before, the more completely intelligent men are organized the easier it is to carry on amicable negotiations with them. If several persons offer themselves as candidates for the position of fireman or for promotion to that of engineer, a railroad company is of course right in selecting the best men. If it has a choice of employing either those who are ignorant or those who are more or less educated, it is right in selecting the educated one, other things being equal.

That the best men may be selected it is absolutely essential though that the selecting power should be impartial and just. There can be no doubt that on some roads it is far otherwise. The appointing power is intrusted to one person without any check whatever, and is exercised in whatever way serves his personal interest best. Promotion is then attained only through servility, and the system says in effect to the employés, "Advancement is a game of intrigue and influence; court the great officials who can favor your appointment; be submissive to them and excuse their sins; attack no existing abuse which may deprive you of your place."

It is painful to see the attitude of abject servility which the men on some roads are compelled to assume to their superior officers. So long as this condition of things exists, it is impossible to get the most efficient service from employés. A man to do his best should be able to respect himself as well as his superior officers; he should stand on his own worth and take an honest pride in his work and his record, and command the respect of his fellows and of the community. That this may be the case, it seems absolutely essential that he should not be dependent on the will of one man alone for his appointment and promotion. To withhold from a man the reward of faithful service, or to deprive a man of employment without sufficient cause is very grave injustice. For this reason, and to guard against the abuse of power of this kind, if it is intrusted without restriction in one person's hands, a board of appointment and promotion might be established, consisting of one person representing the machinery department, another the transportation department, and a third appointed directly by the president or general manager. It would not be difficult for such a board by an oral examination to learn all that it would be desirable to know about a candidate, and which could be learned in this way. A record of his previous life and conduct could be submitted to the board and be verified, and due importance be assigned to a physician's report of the candidate's health. It would be easy, too, to test his power and the quality of his vision. The appointment then could be made by a majority of the board. If this power was delegated in this way it would make it much less likely to be exercised unfairly. It would, too, subject a candidate to an examination by a representative of the two departments whose rules he would be called upon to obey.

It has been said, and very truly, "that most men are disheartened if they do not in the course of a certain period, say ten years, obtain a distinct rise in their positions." It therefore seems very desirable that an opportunity should be offered to men to present their qualifications and claims for advancement. On some roads locomotive engineers are divided into three or four classes, with pay graded to the classes. On such roads intelligence and faithful service is rewarded by advancement in their classes. The privilege which it seems proper to assign to seniority in service is to have it entitle a person, at the end of say every five years, to appear before such a board of advancement as has been described for examination to determine his fitness for promotion, either from the position of fireman to that of engineer, or from one of the lower engineer grades to one of the higher.

The examination before such a board need not be exclusively an oral one. To know whether a person can discern a signal at a distance of 3,000 ft., or can tell whether it is red or green at half that distance, is a question of fact. The physical condition of a man is one that a doctor can report on most intelligently, and can then be duly considered by a board of examiners. A very good idea may be formed of a man's knowledge of

the principles of a locomotive engine by asking him questions, but of his skill as a fireman the fuel record of the engine on which he has been employed would be much more conclusive than questions and answers could be. Most experienced master mechanics would rather form an opinion of a fireman's skill in packing a piston-rod, setting out the rings of a piston, or calking leaky tubes by sending him in the shop and seeing how he would do it, than they would from the replies he would make to a cross-examination.

As an experienced master mechanic said to the writer: "I watch a fireman and see how he does his work and how he starts up an engine, and judge a good deal by what he does whether he is worthy of promotion."

It would not be difficult to devise a system of practical examination of this kind, which could be employed by a board and which with merely oral questions and answers could be supplemented, and which with the latter would indicate very distinctly how much skill and how much knowledge a candidate has.

Unfortunately, there is no test that we know of which will tell whether a man is a hero or not, excepting an actual trial itself, and the result of that, alas! is often revealed only by the death of the person whose courage is in question.

TRAIN ACCIDENTS IN 1880.

Last week we published our record of train accidents for December last, which enables us to review the accidents of the year 1880—the eighth for which we have compiled these records—and compare them with those of the other seven years. But first of all we desire to impress upon the reader what the character and sources of this record are, to prevent mistakes that are very commonly made. This being the only record of accidents made for the whole country, the annual reviews, or the statistics in them, are used and commented on by many here and abroad who are unfamiliar with the paper and the character of the reports as shown by the detailed statements given in the monthly record. This explanation we give in the words used in our review for 1879, as follows:

"The record is of train accidents only—accidents *to* trains—and takes no account of injuries caused by trains, or otherwise, to persons on the track or grounds of a railroad, unless these are connected with an accident to the train. By far the largest number of persons injured, and especially of those killed, on railroads, are not hurt on the trains, but are hurt *by* them while standing on or near the track. Most of these are trespassers, and most of the rest are employés engaged about the trains or the tracks. Neither does this record include the considerable number of persons who are injured by falling from running trains. Information on all these heads is desirable; but it is beyond our power to collect it. Some of the states require the railroads to report it, as New York and Massachusetts. It is, however, useful mainly for quite other purposes than the statistics of train accidents, which, under any circumstances, ought to be reported separately. The chief lesson of the casualties to people on the track is the great danger of grade crossings, the necessity of enforcing caution among employés in yards and about trains, and of providing the appliances which require the least exposure in coupling and uncoupling cars and allow the least risk of falling from them, etc. Train accidents result from much more numerous causes, and immunity from them would require the perfect construction and maintenance of road and rolling stock, and a perfect administration and discipline. The frequency of accidents of one kind or another is, to some extent, an index to the weak points of railroads and their operating management. The record directs attention to the evils to be avoided and the dangers most to be guarded against.

"The source of our information for this record is chiefly the newspapers. Journals from all parts of the country are examined, many of them for this special purpose, and we think that not many accidents escape us that are reported at all. We get some information by letter, which is often valuable as describing the accident more definitely, or giving its cause more certainly, than the newspaper accounts do.

"It is certainly true that only a fraction of the whole number of accidents is ever reported. Derailments of freight trains, unless they cause considerable damage to rolling stock or long delays to passenger trains, are rarely reported. Derailments of passenger trains which cause but trifling delay, and no damage to rolling stock or persons, often are not reported. But nearly all accidents that cause loss of life or serious injury to any one, and most that cause the destruction of rolling stock, or any long delay of passenger trains, are reported; and of *accidents of this kind*, our record, we believe, is pretty complete. It is a list of the kinds of accidents which do most harm, and as such has a special value.

"Of course, our sources of information being what they are, we can be by no means sure that each accident is properly described or has the true cause assigned to it. But this is not likely to make much difference with the aggregates and the averages, in which the chief value of the record is found."

The number of accidents in each month of each of the past eight years has been:

Number of Train Accidents Each Month for Eight Years.

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
January	178	108	131	60	147	75	113	62
February	133	90	211	91	56	67	88	64
March	112	88	122	109	58	49	61	65
April	101	59	60	56	69	46	50	71
May	79	89	54	64	46	50	37	46
June	90	83	61	52	49	56	64	56
July	90	64	73	79	53	54	81	78
August	150	73	114	78	98	75	79	112
September	106	89	116	106	84	76	78	124
October	88	81	88	103	82	61	104	120
November	76	82	87	96	83	68	86	145
December	80	74	84	88	66	63	69	135
Total	1,283	980	1,201	982	891	740	910	1,078

These numbers of the monthly accidents are worth studying, with reference to the weather at the time and to some other circumstances not at once apparent. As we have pointed out every year, accidents are much more numerous in severely cold and especially in snowy weather, for a variety of reasons. Only one of these, if it is one, is the effect of cold on iron. Although there are many more rail breakages in cold than in mild weather, it is not so clear that they are caused by greater brittleness of the iron. Unballasted road-beds are likely to be frozen up rough, and when the rails are supported at irregular intervals on points of earth as solid as a rock they of course are much more likely to break than when their support is elastic. But, further, snow and ice themselves often throw trains from the track, and they cause great delays and irregularities, which are among the most prolific causes of accidents. Further, it is natural to suppose that very severe cold distracts the attention of train-men and switchmen from their duties: if they are like other men they keep in their cabins and cabooses as much as possible, and sometimes more than is safe, when the thermometer is below zero. When nearly all tracks were iron (and much rougher than in these days), very severe weather was always accompanied by a great number of accidents from broken rails; but, though accidents from this cause are still more numerous in very cold weather, nothing like the number has been reported this winter—perhaps the coldest of all—as in 1873 and 1875 and some other winters several years ago.

This we illustrate by the following table, showing in the first line the number of derailments from broken rails in the three months of January, February and March of the eight years, and in the second line the number from the same cause in the three months of July, August and September:

Accidents from Broken Rails in the First and Third Quarters of the Calendar Year, for Eight Years.

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	Total.
First quarter	65	20	90	26	26	7	34	7	275
Third quarter	5	5	3	5	7	2	5	7	39

Thus in the aggregate for the eight years there have been *seven times* as many accidents from broken rails in the three winter months above as in the three summer months. And the evidence is not weakened but strengthened by the experience of 1880, in spite of the fact that the broken rails were as numerous in summer as in winter that year; for last winter, as all will remember, was a phenomenally mild one, with no very severe cold weather, and very little snow. And while in the first three months of 1880, which were very mild, we had but seven accidents from broken rails to record, in the last two months of the year, in which there was an unusual amount of severe cold weather and snow, we reported 26 such accidents.

But there is something more to be learned from this monthly record. We see that during the first seven months, the number of accidents monthly was never very much greater in 1880 than in 1879. In January it was much less; but January was a snowy month in 1879 and mild and springlike in 1880. In these seven months we recorded 442 accidents in 1880 against 494 in 1879, and in no year of the eight, except 1878, have we had so few accidents to record in these seven months. But after July there was a horrible revolution, and in the following five months the number of accidents was not only greater than the year before, but much greater than in any other year of the eight, as will be seen by the figures below:

Number of Accidents in the Five Months Ending with December, for Eight Years.

1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
500	399	489	471	413	343	416	636

We may account for a part of the increase of more than 50 per cent. over 1879 by the severe weather in the last two months of the year, but that does not avail to account for the increase of 37 per cent. in the other three months. Further, it cannot be explained by the poverty of the roads and their inability or neglect to maintain their roads and rolling stock; the railroads were never more prosperous in their history and had never, probably, made expenditures more freely for improvements.

We believe that we must look for the cause of this great and sudden increase of railroad accidents to a great increase in the number of railroad officers and employés who have had insufficient experience and training, due to the sudden great increase in the length of new roads constructed, together with the growth of traffic. It must be remembered that the decrease in the number of accidents since 1873 has been in spite of a constant increase in mileage. But this increase has not been so great at any time heretofore but that a sufficient number of men could be trained to work all the new roads without diminishing the effectiveness of the force on the old ones; further, in spite of the increase in mileage and traffic, which was considerable before 1879 and 1878, there was a very moderate increase in train mileage, and on many roads none at all. As we have shown repeatedly, the great reduction in expenses of late years has been due very largely to the carrying of larger train loads. In the great reduction of forces that took place after 1873, naturally it was the most effective men that were retained. But the increase in new road from 2,916 miles in 1878 (and an average of 2,088 miles in the four years previous) to 4,570 in 1879 and 7,150 in 1880, greatly increased the demand for skilled railroad men, some of whom are engaged in constructing as well as operating new roads. Doubtless the new roads are insufficiently supplied (and it is a task of great difficulty to stock a road with an effective working force, and the best of men have much to learn on a new line), and still the drain on the old roads—especially those that have greatly extended their own lines—has left them with a less effective force than formerly. This seems a rational explanation of the great increase in the number of accidents of late months, and it gives warning that in such times as these extraordinary pains should be taken to secure good material and to train the working force. This view will be strengthened when we come to the classification of the accidents as to their nature and causes, when we will find that it is precisely those due to carelessness and negligence that have increased most.

By this great increase in the accidents of the last five months of the year the total number in 1880 becomes 18½ per cent. greater than in 1879 and 46 per cent. greater than in 1878, and exceeded only in 1875 and 1873, in which latter year a half-trained force on a system of roads, one-third of which had been recently built and were not really finished, while most of the rest were very imperfect in roads and equipment, and especially in rails, combined with terrible winter weather to cause great devastation. It is since that time that nearly all the continuous train brakes and steel rails have been introduced.

The numbers of train accidents and of persons killed and injured by them reported in our record for each of the past eight years have been:

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
Accidents	1,283	980	1,201	982	891	740	910	1,078
Killed	276	204	234	328	214	204	185	315
Injured	1,172	778	1,107	1,097	1,047	756	709	1,172

Thus, not only have the accidents been more numerous, but they have been more deadly than usual. Only in one year (1876) have we reported more killed by train accidents, and never more injured (in 1873 just as many). Compared with 1879, there is an increase of 70 per cent. in the number killed and of 65 per cent. in the number injured, while the number of accidents was but 18½ per cent. greater. In 1879 there were 2.03 persons killed and 7.80 injured to every 10 accidents: in 1880, 2.93 killed and 10.87 injured. Very seldom indeed have accidents on the average had such serious consequences, and considering the quite general use of improved safety appliances, especially powerful continuous brakes, by which the consequences of negligence are very greatly mitigated and reduced, this is further evidence of greater negligence and less skill in employés, and especially train-men.

It is to be expected that the increase in mileage of itself will tend to increase the number of accidents, but when the increase is chiefly in new country, as during the past two years, where traffic is thin and the number of trains is too few to cause complication, the increase in accidents should not be in proportion to the increase in mileage.

The classification of the accidents of each of the past seven years according to their nature or causes gives the following results:

	1880.	1879.	1878.	1877.	1876.	1875.	1874.	1873.
COLLISIONS:								
Rear	74	206	142	159	159	141	131	187
Butting	141	106	70	96	94	114	87	102
Crossing	22	17	7	13	15	18	19	31
Unknown	..	1	1	..	11	15	23	72
DERAILMENTS:								
Unexplained	237	192	175	177	185	222	218	315
Broken rail	45	56	17	46	50	107	42	111
Misplaced switch	80	89	48	70	89	81	67	72
Cattle on track	43	35	30	43	46	51	45	54
Wash-out	17	11	36	17	49	44	10	30
Loose or spread rails	21	19	29	41	43	40	16	13
Broken axle	30	30	18	43	38	39	20	21
Accidental obstruction	25	24	26	22	36	37	51	44
Snow or ice on track	8	22	13	25	16	36	13	9
Broken wheel	21	21	5	12	22	33	20	26
Broken bridge or trestle	16	17	21	21	20	25	33	19
Malicious obstruction	8	11	15	11	11	21	22	11
Broken truck	7	11	13	8	10	15	8	7
Broken or defective switch	5	2	1	6	4	15	12	10
Land-slide	4	7	4	11	9	11	..	..
Broken or defective joint	..	..	2	2	1	10	5	3
Broken or defective frog	2	..	2	2	3	8	8	4
Wind	3	3	1	2	2	7	..	..
Rail removed or displaced	4	4	5	7	7	8	7	16
Broken parallel or connecting rod	2	..	..	..	..	5	..	..
In making flying switch	1	..	..	..	2	4	1	..
Failure of coupling or draw bar	1	2	4	1	1	3	7	8
Broken car	3	..	1	1	2	3	..	..
Runaway engine	5	1	2	1	..	3	1	6
Running through siding	5	3	6	3	6	2	2	3
Loose wheel	1	2	..	1	3	2	4	2
Open drawbridge	1	2	1	4	3	2	6	4
Bad track	..	..	..	..	4	..	13	7
Fall of brake or brake beam	..	..	..	..	..	..	4	9

DERAILMENTS:	1880.	1879.	1878.	1877.	1876.	1875.	1874.	1873.
Careless stopping or starting	1	..	..	..	..	..	2	..
Overloading car	1	..	..	..	1	..	3	..
Bad switching	..	..	..	..	..	..	2	..
Running over a man	..	..	..	..	..	..	..	..
Flood over track	..	..	..	..	..	..	..	2
Others (one each)	1	2	3	4	1	3	11	7
ACCIDENTS WITHOUT COLLISION OR DERAILMENT:								
Boiler explosions	14	17	11	15	19	26	14	16
Cylinder explosions	3	1	1	..	3	3	4	3
Broken parallel or connecting rod	13	15	11	13	7	14	8	11
Broken axle	3	1	..	1	2	13	..	..
Cars burned while running	6	4	13	7	11	10	16	2
Broken tire	..	3	..	1	..	9	..	..
Broken crank pin	..	..	..	1	..	2	..	..
Flue collapsed	..	1	..	3	..	1	4	..
Other breakages of rolling stock	1	1	..	2	4	5	10	19
Steam-chest explosion	..	..	..	..	..	..	2	..
Flue-plug blown out	..	..	..	..	..	..	2	..
Failure of bridge or trestle	..	..	..	..	..	..	2	..
Mass falling on running train	..	..	..	1	1	..	2	2
Accidental obstruction	3	..	..	..	..	..	..	11
Malicious obstruction	1	..	1	..	1	..	..	3
Unknown	..	..	..	..	..	..	2	9
Totals	1,078	910	740	891	982	1,201	980	1,283

RECAPITULATION.

	1880.	1879.	1878.	1877.	1876.	1875.	1874.	1873.
Collisions	437	310	220	268	279	278	260	392
Derailments	597	557	481	581	655	840	654	815
Other accidents	44	43	39	42	48	83	66	76
Totals	1,078	910	740	891	982	1,201	980	1,283
Average No. per day	2.95	2.49	2.03	2.44	2.69	3.29	2.08	3.51

As we said before, this classification shows a great increase in the accidents due to negligence and blundering. Such are collisions of all kinds, and of these the number reported in 1880 is frightfully large—41 per cent. more than in 1879 and nearly twice as great as in 1878. And the increase is especially great (64 per cent.) in butting collisions, which are the most atrocious kind, and less liable than rear collisions to follow the crowding of the road by an increase in the number of trains. Next to collisi ons as evidence of undisciplined and negligent employés are derailments by misplaced switches, and of these we record no less than 80, which, though no greater a number than the year before, were, like the collisions, more numerous in the last five months of the year, in which there was an average of 8.6 derailments by misplaced switches and 56 collisions monthly, against 5.3 switch derailments and 22.4 collisions in the first seven months of the year. The first class of accidents was thus more frequent by half, and the latter two and two thirds times as frequent in the last five months of the year. Further, there were 34 collisions attributed to misplaced switches in 1880 against 19 in 1879, and 10 out of 14 boiler explosions were in these five months. This indicates a deplorable condition of things *now existing*, and demands the greatest energy, determination and devotion on the part of railroad managers and all their subordinate officers to remedy it. With the present great activity in railroad construction it is likely to be more difficult this year than last even to maintain an efficient staff of officers and employés, and with the great activity in other pursuits it will not be so easy as heretofore to get the best raw material to make skilled employés of (and officers also).

This year for the first time we have kept a record of the time (whether day or night) that the accident occurred. The result for the year is that 622 occurred by daylight and 343 after dark, while of the other 113 the time of day is not reported. Thus, of those whose time is reported, 35½ per cent. occurred when it was dark. We are not able to draw any conclusions from this fact by itself. Doubtless there are accidents which are much more likely to occur by night than by day, but then there is a large class less likely to occur by night, when there is little interference by other than railroad traffic, and when animals as well as men are more likely to be out of the way, and there is little to distract attention.

Of the derailments for which causes are assigned, the percentage due to each of the chief causes was as follows in the several years :

	1880.	1879.	1878.	1877.	1876.	1875.	1874.	1873.
Broken rail	12.5	15.3	5.6	11.4	10.6	17.3	9.9	22.2
Misplaced switch	22.2	21.9	15.7	17.3	18.9	13.1	15.4	14.4
Cattle on track	12.0	9.6	9.8	10 6	9.7	8.2	10.3	10.8
Wash-out	4.7	3.0	11 8	4.2	8.5	7.1	2.3	6.0
Loose or spread rails	5.8	5.2	9.5	10.1	9.2	6.5	3.7	2.6
Broken axle	8 3	8.2	5.9	10.7	8.1	6.3	4.6	4.2
Accidental obstruction	7.0	6.6	8.5	5.4	7.7	6.0	11.7	8.8
Broken wheel	5.8	5.8	1.6	3.0	4.7	5.3	4.6	5.2
Broken bridge	4.5	4.7	6.9	2.4	2.0	2.2	3.4	1.5

The proportion of derailments by misplaced switches was thus last year larger than ever before. The number of derailments for which causes are assigned was a little less than in 1879.

A more general classification of the causes of derailments gives the following :

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
Defects or failures in permanent way	200	143	261	165	137	72	94	106
Defects or failures in rolling stock	73	63	101	76	67	42	64	64
Negligence or malice	96	107	114	119	97	82	101	126
Unforeseen obstructions	111	100	142	107	113	110	99	84

The number of each class of trains involved in collisions, derailments, and other accidents, and the number of the killed and injured under each head were :

Accidents:	Collisions.	Derailments.	Other accidents.	Total.
To a passenger train	42	212	28	282
To a passenger and a freight	123	...	..	123
To a freight train	272	385	16	673
Total	437	597	44	1,078
Casualties:				
Killed by	156	143	16	315
Injured by	412	714	46	1,172
Killed and injured by	568	857	62	1,487

There being two trains involved in each collision, this gives 447 passenger trains and 1,068 freight trains involved in accidents during the year. More people were killed by collisions than by derailments, but not nearly so many injured. Of the 156 killed by collisions no less than 131 suffered by accidents in the last five months of the year, and 310 out of the 412 injured by them suffered in the same months. In 1879 the collisions were very much less serious, as may be seen below:

		Collisions.	Derailments.	Other accidents.	Total.
Killed by	1879	64	97	24	185
	1880	156	143	16	315
Injured by	1879	286	389	34	709
	1880	412	714	46	1,172

All this shows a lamentable state of things; the best that can be said of it is that it is an excellent record to improve upon.

The Corn Crop of 1880.

The corn crop of 1880, as estimated by the Agricultural Department, is nearly the same as in 1879 (about ⅓ of 1 per cent. less). It amounts to 1,537,500,000 bushels, while the wheat crop, of which we hear so much, has never exceeded 480,000,000. Corn is by far the most important crop of the United States, though it is not largely used as a breadstuff, except in the South, and the large exportations to Europe of late years have not been to feed the people, as many suppose, but chiefly as food for animals, and horses especially. The corn that is sent to market comes chiefly from the seven states of Ohio, Indiana, Illinois, Iowa, Nebraska, Missouri and Kansas. Further north the summers are too short to permit the more productive varieties to be cultivated safely, and the production is limited chiefly to what is needed for home consumption, while the large quantities consumed in the lumber regions of Michigan, Wisconsin and Minnesota come chiefly from states further south. Indeed, the seven states we have mentioned in 1880 produced about 950,000,000 bushels out of the total of 1,537,500,000 or 61.7 per cent. of the whole, while the year before they produced more than 1,000,000,000, and 66.4 per cent. of the whole. It is important to understand where the great corn-growing district is, because not only do the corn shipments come thence, but also the great shipments of hogs and hog products, and most of those of stall-fed cattle Minnesota, for instance, which is an important wheat state, last year produced but one-thirteenth as much corn as Iowa, which is the second of the corn states, Illinois leading with 262,000,000 bushels in 1880 and 309,000,000 in 1879—in the latter year one-fifth of all raised in the country. Iowa, when its land is generally made into farms, will probably lead, though the northern part of it is not the most favorable corn climate, and Missouri is more exactly in the corn belt; but Iowa has probably twice as much fertile prairie land as Missouri. Corn-growing is not confined to the West, however, by any means. Corn is almost the only grain grown in the South, and there it forms the chief bread of the negroes everywhere, and of the whites outside of the towns; that is, of the great mass of the people. All the states south of the Ohio and the Potomac, except South Carolina, Florida and West Virginia, grew more corn than Minnesota last year; Texas grew more than Nebraska, and nearly as much as Kansas. The cotton-growing states, however, cannot compete with the Northwest in producing corn, and they import from them a good deal of corn and still more provisions. The average crop per acre in these states is not probably more than one-third of the average in Illinois. But, besides the South, the East produces considerable corn. Pennsylvania alone is credited with 66,900,000 bushels last year, and our total exports that year were but 84,700,000 bushels ; but in the East the corn is nearly all consumed near the place of production.

Though, as we have said, the most of the corn is consumed near the place where it is produced, still there is an immense amount of it transported, and much more than we can trace by the ordinary reports of grain movement; for vast quantities of this grain are consumed in every considerable city, West as well as East, as food for animals, and in many for distilling, making starch and, lately, glucose. And shipments of corn much more than those of wheat are sent from the farmer's stations in the West directly through to the interior towns of the East where it is consumed, and of this the reports of the exchanges give us no record. Wheat is not so sent, because it must first go to the mill. As the states which export most corn produced about 77,000,000 bushels less in 1880 than in 1879, we may expect the movement to be lighter this year than last. It is true the decrease has been mostly made up by gains in the Eastern and Southern states, but it is to these that the West exports chiefly (much more than to Europe), and the more they produce themselves the less they will take from the West. Moreover, the West probably had more hogs to feed from the last crop, and they take probably more than half of the crop. From July to January the corn movement was nearly 50 per cent. greater than the year before; but most of the corn moved then was of the crop of 1879; the new corn does not come forward much until the year after it is grown, and not very largely until the next spring. During January the corn receipts were 35 per cent. less at Northwestern markets and 43 per cent. less at the Atlantic ports—at the latter, the smallest for four years.

Rail Importations.

British rail exports show the large increase of 56 per cent. in 1880 over 1879, the exports of steel increasing about 40 per cent. and of iron 153½ per cent. The total rail exports were sufficient to lay 6,865 miles of track with 56 lbs. rails. The increase was almost entirely due to the revival of exports to the United States, which, until the latter part of 1879, had imported scarcely any rails for several years. In 1879, however, we took about a ninth, and in 1880 more than a third (36.2 per cent.) of the total British exports; and of the increase in these exports over 1879 we took more than four-fifths. The increase in British exports was much greater in iron than in steel rails, though for several years previous the exports of iron had been falling off so fast that they seemed likely to disappear entirely, as was natural when we consider the small difference in price. (The average value of the exports in 1879 was given as $25.94 for iron and $28.57 for steel, while the steel would probably last five times as long as the iron). Here again the cause of the increase in iron exports has been due to the demand from this country, for of the increase in iron rails exported we took more than nine-tenths, and of the whole quantity of British iron rail exports no less than 70 per cent. (against 26 per cent. of the steel rail exports). The reason why we have imported iron rather than steel has been, not because iron is so much cheaper than steel in England, for it is not (on the average only $2.50 a ton cheaper in 1880), but because the duty on iron is only half as much as the duty on steel ; so that iron worth $2.50 a ton less than steel in England is worth $16.50 less than the same steel when brought to this country.

The exports to this country were largest (at least the purchases were) early in the year, when prices here were about a third higher than they have been since. But there are considerable imports still, the shipments to this country in December last being 13,646 tons, while the average per month for the year was 18,210 tons. It appears, then, that the domestic production has not yet quite caught up with the consumption. It has very nearly, however, for our exports in 1880 were only sufficient for 2,483 miles of track. But we built 7,150 miles of new road that year, requiring, as nearly as we can calculate, 680,000 miles of rails. Moreover, we probably used for renewals and for additional tracks and sidings of the 86,000 miles completed at the beginning of the year about 745,000 tons more, so that of a total consumption of 1,425,000 tons only 218,500, or 15⅓ per cent., came from abroad, and of an *increase* of about 430,000 (long tons in the demand—an increase not suspected until just before the year begun—the American works were able to supply three-fifths. To keep pace with the demand when the demand fluctuates so greatly as by an increase from 4,570 to 7,150 miles of new railroad in a year may not be very difficult for the iron industries of the whole world, but for those of a single country it requires an extraordinary expansion and activity.

The prices of rails now have fluctuated little for several months, and are about a fourth less than the highest prices reached last year. These prices seem to be satisfactory to the manufacturers, and there are at present but comparatively small imports. It is understood, however, that with any advance in iron rails the foreign works would probably supply the bulk of the demand; the home prices of pig iron caused by the demand for steel and for other purposes being such that the rolling mills cannot afford to make rails for less. The present prospect is of an enormous demand, but the manufacturers have so far increased their capacity for production that they will probably be able to supply a larger proportion of it than last year even, as is indicated by the fact that prices do not advance nor exports increase in spite of the great demand.

Record of New Railroad Construction.

This number of the *Railroad Gazette* contains information of the laying of track on new railroads as follows :

Scioto Valley.—Extended from Portsmouth, O., southeast to Ironton, 28 miles.

Richmond & Allegheny.—Extended westward to New Canton, Va., 11 miles.

This is a total of 39 miles of new railroad, making 110 miles reported thus far in 1881.

COLORADO has been discussing the propriety of establishing a railroad commission, but a bill to that effect was defeated in the state Senate last week by a vote of 8 to 16. Apparently the movement was made by those who wished to restrict greatly the rates charged by the companies, and it was defeated because it was known that any such action would check railroad construction in the state and very greatly limit its development at a time when it is making great progress. But it is by no means necessary that a commission should have this effect; and if its authority is properly limited it will not. Railroad construction, we venture to say, has never been checked in Massachusetts, Ohio or Michigan by the existence of their railroad commissions; but outrageous restrictive legislation, such as has often been connected with the establishment of commissions, is

very likely to put a full stop to it. The case of Colorado is peculiar. There are very few parts of it that can supply a railroad with a heavy traffic, on even what in the states further east would be considered a tolerable traffic; but the traffic in the mining districts is often of such a nature that a very small amount of it can support a railroad—that is, it can afford to pay high rates, and until a railroad is established often uses ox-teams and even pack animals at enormous rates—more per pound, perhaps, than is paid per ton for through freight in the East. But the Colorado people have, nearly all of them, come from the East, and are familiar with Eastern railroad rates, and, unmindful of the mule team charges, for which their railroad charges have been substituted, complain because the latter may be several times as high as on some Eastern road. Nevertheless, until within about two years, we believe that none of the principal railroads in Colorado have paid interest on their cost: there are one or two little ones whose reports we have not seen. But the sudden rush to a new mining district, such as there was to Leadville recently, may at once give one of these roads three times its ordinary traffic, without reducing, but on the contrary tending to advance the rates. Thus a given line in one year may make 30 per cent. on its cost which had never made anything before, and will not thereafter make 10 per cent. and may become almost valueless. In Colorado last year the Denver, South Park & Pacific and the Denver & Rio Grande must have made great profits by the rush to the mining regions, especially to Leadville. But the latter had not always been able to earn the interest on its bonds before, and the South Park road, as we showed last week, has had its earnings fall off from $1,173 per mile in December, 1879, to $412 in December, 1880. Under such circumstances, that is, where there are great fluctuations in traffic, it is an indispensable condition of the establishment of railroads that they should be permitted to make and divide very large profits in the years when this is possible.

THE FOURTH AVENUE IMPROVEMENT, as it is called in New York city, consists substantially of a long, open cut with bridges carrying the cross streets over it and, for some distance, a bridge carrying the tracks over the streets, between the Grand Central Depot and the Harlem River in New York, a distance of about four miles. Over it the tracks of the New York & Harlem Railroad enter the city, on which enter the trains of the New York Central & Hudson River and the New York, New Haven & Hartford roads also. Formerly the tracks were on the surface; but as the city grew this became very dangerous, and at an expense of some millions of dollars the "improvement" was made by the city and the railroad company jointly and at their joint expense. Having been completed, the City Tax Commissioners assessed the improvement as real estate belonging to the New York & Harlem Railroad Company. Hereupon the company took the ground that it did not own the "improvement," that it was an improvement of the street and not of the railroad, which had not for its own use any need of the structure, which includes, besides the excavation (partly in rock), a great number of bridges carrying the streets over it. This claim has been allowed by a decision of the General Term of the New York Supreme Court, which says that the company owns and may be taxed for only the railroad, just as if it were on the surface of the street, and the easement, or right of using the street as a railroad route. Its expenditure for the improvement the Court considers as the price paid for the easement. The Court says that the case is a novel one, and that there are no precedents for it. It seems strange, however, that it has not arisen before. It would seem to be public policy, at all events, to have such improvements free from taxation. There must be immense expenditures of a similar kind in this country as the population grows denser, which will be made chiefly for the relief and safety of travel on the streets, and which consequently will often not increase the earnings or lessen the expenses of the railroad companies, and which therefore they are none too much inclined to make. If now the companies are to be taxed for the structures (sometimes very costly), which they do not make for their own but the public benefit, they will be still slower to undertake them. There are many cities in the country where communication is terribly interrupted by railroads crossing the streets at grade, and the condition of things in some of them will soon become insufferable unless the tracks are put over or under the streets, which generally cannot be done without great expense.

JANUARY EARNINGS, as reported in a table for 42 railroads in the *Commercial and Financial Chronicle* (eleven for but three weeks of the month), show an increase of 8.8 per cent. over last year, while the mileage of these roads was 18.5 per cent. larger this year, and the average earnings per mile *decreased* from $426 to $391, or 9 per cent. There is no report in this table for eastern trunk lines, except the Grand Trunk, which shows an increase of four per cent. But the average may very well represent the general condition of railroad business. January has been a very hard month for operating railroads north of the Ohio, owing to the frequent snow storms and severe cold. Many of the lines have had great difficulty in keeping their trains going, and their ability to carry has been greatly limited. The wretched condition of the streets in Eastern cities has disturbed railroad traffic to an extent that most people would not suppose possible. The impossibility of carting away the freight as fast as it arrived has compelled the railroads to accumulate cars at this end of the lines until their loads could be disposed of, which limits the amount of rolling stock available to take freight in the West, though there has generally been enough for the traffic offering. But if the roads were not so blocked by the weather they would probably not be satisfied with the business they are doing, and if they are satisfied now, it is because in their present crippled condition they are not able to do any more. Shipments westward have not been so light before for many months. This, with the lower east-bound rates, makes it appear remarkable that the roads have done so well. Last year the weather was almost perfect in January, and the traffic, though the lightest of the year, still heavy for January, while east-bound rates were higher than now. We are now approaching the time when a reduction in east-bound rates usually takes place, to enable the roads to get a share of the grain accumulated during winter in the elevators at the lake cities, before navigation opens. Last year a reduction was made March 1, but last year it was already evident that there would be an early opening of navigation. This year the polar weather has locked the straits faster than ever before, probably; and though this does not absolutely preclude an early opening, it makes it less probable.

Expenses this winter must be very much greater than last, chiefly on account of the unfavorable weather, so that it is probable that the roads generally have made considerably smaller profits this year than last since navigation closed.

GUILTY OF MANSLAUGHTER is the verdict rendered last week by the jury in the case of David C. Bogart, the switchman of the New York & New Jersey Railroad who, last November, let a freight train enter a siding, and then went away, "forgetting" to turn the switch to the main line, and so caused a passenger train to run into the freight and kill the engineman and fireman. In the course of the trial Bogart, who is only 19, said he thought he must have gone to sleep (he opened the switch to the siding some time before the train entered it, and then went to his cabin). Properly the judge charged that this was no excuse. We may recall the fact that sentinels found asleep on their posts in time of war are liable to be shot, though no harm may come of it at the time; and the position of the switchman is probably on the average at least as responsible as that of a sentinel, except that the disaster from his negligence is limited to the destruction of a train-load or two of people, while the sentinel's neglect may lose an army. But it cannot be too strongly insisted upon that vigilance and exactness in attending to switches is a matter of life and death, and that the men in charge will be held responsible accordingly, and no excuse of forgetfulness or sleepiness be allowed. But further, this also makes it important that trustworthy men should be selected for switchmen, and that frequent inspections should keep them alert, and inform the management of the manner in which they perform their duties. But for the constant inspections, sentry duty in the army would certainly be neglected, because it is often done by men of the meanest capacity and lowest character; but by a system of constant inspections, which makes it not only possible but probable that negligence will be detected, and by severe punishments for negligence when detected, the duty is generally well performed.

THE THROUGH PACIFIC RAILROAD TRAFFIC, as reported by the General Freight Agent of the Central Pacific to a San Francisco newspaper (December partly estimated), has been as follows for the last two years:

	1880.	1879.	Increase.	P. c.
East-bound	113,644	85,103	27,941	32.8
West-bound	164,024	134,581	29,443	21.9

Contrary to the general course of things in this country the traffic westward exceeds that eastward. However, the total current of traffic from California is probably not very different from that of Western states, only the freight which forms the great bulk of the state's shipments (wheat) goes entirely by sea (472,605 tons in 1880). But in the rail movement, the westward movement exceeded the eastern 45 per cent. in 1880, and 58 per cent. in 1879. The increase in traffic in 1880 was very large, but still it can hardly be called a heavy traffic, as the west-bound business was equivalent to but 52 10-ton car-loads daily—an amount, by the way, which does not offer much temptation to construct rival roads for the sake of through traffic. The bulk of the local traffic was five and a half times that of the through, though on most of it the average haul is very much less. This local traffic, by the way, was 22 per cent. greater in 1880 than in 1879. The tea imports at San Francisco, which have been spoken of as a chief support of present and future Pacific railroads, were 11,037 tons last year, or about 3½ car-loads daily, part of which is for consumption on the Pacific coast.

THE WINTER PACKING SEASON, of which February is the last month, has been very active for the three months ending with January, in which 6,305,000 head of hogs were packed in the Northwest, which is 12.2 per cent. more than last year, but a little less than the year before. Chicago not only has kept but has increased its lead, packing about three-eighths of the whole number, and four and a half times as many at Cincinnati, which stands second this year (St. Louis was second last year). Chicago's gain this year is the same as the number packed at Cincinnati. St. Louis packed a much smaller number this year than last. The most important gain was at Kansas City, which packed 255,000 this year against 153,700 last, an increase of 66 per cent. The importance of the business to the railroads may be judged by the fact that the shipments of hog products from Chicago alone in these three months amounted to 207,986 tons, which would make 16,000 full car-loads of 13 tons each, an average of 200 car-loads daily, the freight on which, if shipped to New York, would have amounted to about $2,000,000.

IMMIGRANT RATES have been still further reduced during the past week, and Wednesday were as low as $3 from New York to Chicago, but as there is a new reduction nearly every day, they may be lower by the time this paper is published. The Pennsylvania Railroad takes the lead in the reductions, claiming that it should make an equivalent for rates made abroad on tickets sold in connection with steamer tickets. The business is not very large at this season of the year, so that it is probably the best time to fight. There are hints that if there is no settlement before Monday (there is to be a meeting for that purpose), open cutting of ordinary passenger rates may be begun, which would involve much greater losses than there is room for in the immigrant traffic, and would hurt most the roads with the heaviest passenger traffic—that is, the New York Central and the Pennsylvania—and the Erie least.

THE DISCUSSION ON STEEL RAILS, to be held at the Philadelphia meeting of the American Institute of Mining Engineers next week, will open at a meeting to be held in the Hall of the Franklin Institute Thursday morning, Feb. 17, beginning at 10 o'clock. The papers that will serve as texts for this discussion are the papers of Mr. C. P. Sandberg on "Rail Specifications and Rail Inspection in Europe," most of which we have published in our last two numbers, and Dr. C. B. Dudley's paper on the "Wearing Power of Steel Rails," which we publish in full this week, and which is one of the most important contributions to the knowledge of the subject that has ever been made, and deserves the careful study of all who buy and use rails. It is to be hoped that there will be a large attendance of rail-makers and rail-users at the Philadelphia meeting, and a thorough discussion of the subject.

NEW PUBLICATIONS.

The Financial Review for 1881 (being a review of 1880) published annually by the New York *Commercial and Financial Chronicle*, has just been issued, and we again commend it. It contains, in moderate space and easily referred to, very useful statistical and other information, which often has great value and cannot be had elsewhere without much searching among files of periodicals, etc. It has the usual information—a review of the business in 1880, statistics of exports, imports and prices, daily quotations for interest on call loans and commercial paper in the New York money market since 1872; prices of foreign exchange daily for eleven years; a compound interest table and a useful "table for investors," showing the rate per cent. yielded on purchases of securities at prices varying from 10 to 300 per cent. of their par value, bearing interest at 1 to 20 per cent.; an account of the terms and methods used in stock speculation; records of the prices of United States, state and railroad bonds, sold on the New York Stock Exchange, monthly (highest and lowest) for many years (railroad bonds since 1871), and of railroad stocks sold on that exchange ever since 1859 (Harlem, in January, 1860, 8½ to 9½), and the extremely valuable "Investor's Supplement" of the *Commercial and Financial Chronicle* issued with the last number in December. We have several times described this supplement, which is an index to nearly all securities, and especially railroad securities, giving for railroads the amount, rate of interest, dates when interest and principal are due, relative rank, etc., of every class of bonds, and similar information concerning stocks, with the date and amount of the last dividend, together with the latest information concerning earnings, leases, etc., which affects the value of the securities. This publication no one who deals in or has to make examinations of securities can afford to be without.

The reception of the bound volume of the *Commercial and Financial Chronicle* itself (with which the Investor's Supplement is issued every two months) gives us occasion to repeat our commendations of this careful, conscientious, well-informed and intelligent journal, a file of which forms the best commercial history of the country, and the one most easy to refer to. Within the year past this journal has given a great deal of attention to railroad matters, and especially to reviews of individual companies, which makes it more interesting to railroad men.

General Railroad News.

MEETINGS AND ANNOUNCEMENTS.

Meetings.

Meetings will be held as follows:

Peoria Decatur & Evansville, annual meeting, at the office in Pekin, Ill., March 1.

Lehigh Coal & Navigation Co., annual meeting at the office in Philadelphia, Feb. 21.

Dividends.

Dividends have been declared as follows:

Chicago & Alton, 4 per cent., semi-annual, payable March 1. The company increases from 3½ to 4 per cent.

Detroit, Lansing & Northern, 3½ per cent. on the preferred stock, payable Feb. 15. In August last this company paid 3½ per cent. on the preferred and also 2½ per cent. on the common stock.

Cleveland & Pittsburgh (leased to Pennsylvania Company), 1¾ per cent., quarterly, payable March 1.

National Association of General Passenger & Ticket Agents.

In place of the spring meeting, which was to take place in St. Louis, a special meeting has been called, to be held at the Windsor Hotel in New York, March 9, beginning at 11 a. m. The change is made at the request of a large number of members.

ELECTIONS AND APPOINTMENTS.

Baltimore & Ohio.—Col. S. R. Johnston, Master of Road, has issued a circular announcing the organization of the Road Department as follows: "Mr. W. N. Bolling, Civil Engineer, will have charge of the records, maps and surveys appertaining to real estate, right of way, taxes, corporations, etc., on the main line and branches, and such other engineering duties as may be assigned to him from time to time; his office is at Camden station. Assistant masters of road have been appointed as follows: H. B. Baylor, having charge of the maintenance of track of the First Division, embracing terminal stations in Baltimore and main line and branches east of Harper's Ferry; headquarters, Camden station. A. Hunter Johnson has charge of the Second Division, extending from Harper's Ferry (milepost 80) to milepost 240; headquarters, Cumberland. B. T. Fendall has charge of the Third Division, from milepost 240 to milepost 280, and the Parkersburg Branch; headquarters, Grafton. J. A. Hunter has charge of the Fourth Division, from milepost 280 to Wheeling, and the Wheeling, Pittsburgh & Baltimore Division; headquarters, Grafton. The divisions have been divided into subdivisions, designated by numbers and names, as follows: No. 1, all the track east of Gwynn's falls, P. Damast, Supervisor, Baltimore; No. 2, from Gwynn's falls to milepost No. 40, A. Arrington, Supervisor, Sykesville; No. 3, from milepost No. 40 to milepost No. 80, and the Frederick branch, P. McGowan, Supervisor, Frederick Junction; No. 4, from milepost No. 80 to milepost No. 120, J. H. Hobbs, Supervisor, Martinsburg; No. 5, from milepost No. 120 to milepost No. 160, J. Fisher, Supervisor, Sir John's Run; No. 6, from milepost No. 160 to milepost No. 200, Thos. Carr, Supervisor, Cumberland; No. 7, from milepost, No. 200 to milepost No. 240, T. Fleming, Supervisor, Piedmont; No. 8, from milepost No. 240 to milepost No. 280, B. Beery, Supervisor, Grafton; No 11, Parkersburg Branch, from Grafton to Central, C. D. Furbee, Supervisor, Salem; No. 18, Parkersburg Branch, from Central to Parkersburg, R. Malley, Supervisor, Parkersburg; No. 9, from milepost No 280 to milepost No. 335, W. M. Shawen, Supervisor, Grafton; No. 10, from mile post No. 335 to Wheeling, J. W. Floyd, Supervisor, Moundsville; Wheeling, Pittsburgh & Baltimore Division, J. R. Bently, Supervisor, Washington, Pa.; Oliver Kemp, Supervisor of bridges on main line and branch east of Cumberland, and of buildings and water stations between Cumberland and Harper's Ferry, and on the Valley Branch, headquarters, Harper's Ferry; Arthur Sinsel, Supervisor of bridges, buildings and water stations west of Cumberland, on main line and branches, headquarters, Grafton; O. McLean, Supervisor of buildings and water stations east of Harper's Ferry, headquarters, Baltimore."

Belvidere Delaware.—At the annual meeting in Trenton, Feb. 7, the following directors were chosen: Ashbel Welch, Lambertsville, N. J.; Charles Bartles, Flemington, N. J.; Hugh B. Ely, Lewis Perrine, Trenton, N. J.; A. J. Cassatt, George M. Dorrance, Strickland Kneass, George B. Roberts, Edmund Smith, Philadelphia. The board re-elected Ashbel Welch, President; Hugh B. Ely, Secretary and Treasurer. The road is leased to the Pennsylvania Railroad Company.

Boston & Albany.—At the annual meeting in Boston, Feb. 9, the following directors were chosen: George O. Crocker, Moses Kimball, Henry Colt, Edward B. Gillette, John Cummings, Charles S. Sargent and James A. Rumrill.

Boston, Barre & Gardner.—At the annual meeting in Worcester, Feb. 2, the old board was re-elected, as follows: Calvin Foster, George S. Barton, F. H. Kelley, W. W. Rice, Stephen Salisbury, Jr., S. R. Heywood, M. V. B. Jefferson, Worcester, Mass.; Levi Heywood, Charles Heywood, Gardner, Mass.; Isaac N. Ross, Holden, Mass.; Nelson D. White, Winchendon, Mass.

Chesapeake & Ohio.—Robert H. Fisher has been appointed Auditor of Revenue, in place of James F. Netherland, resigned.

Chicago & Alton.—Mr. J. T. Todd has been appointed Division Master Mechanic of the Kansas City and St. Louis divisions, in place of Mr. J. C. Munro, who is going to Mexico.

Chicago & Pacific.—At the annual meeting in Chicago, Feb. 1, the following directors were chosen: Leslie Carter, John M. Cary, Joel D. Harvey, S. S. Merrill, Alexander Mitchell, C. D. F. Smith, E. Walker. The road is owned by the Chicago, Milwaukee & St. Paul.

Columbia & Puget Sound.—The officers of this company (formerly the Seattle & Walla Walla) are: President and Superintendent, T. F. Oakes; Assistant Superintendent, J. M. Colman; Accountant and Cashier, R. Romaine. Offices at Seattle Wash. Ter. The road is now owned by the Oregon Railway & Navigation Company.

Delaware, Lackawanna & Western.—It is understood that Mr. Francis J. Griffiths is to be Superintendent of the Utica, Chenango & Susquehanna Valley Division, in place of W. G. Oakman, resigned. Mr. Griffiths served on the Morris & Essex Division for several years as conductor, was then made Train-Master and for some three years past has been Assistant Superintendent of that division.

Muncy Creek.—Mr. Benjamin G. Welsh has been appointed Receiver of this road.

Fitchburg.—The following circular is dated Jan. 27: "Mr. J. W. Marden is hereby appointed Master Car-Builder of this road, the appointment to take effect, Tuesday, Feb. 1, 1881. He will have charge of the building, repairs and inspection of all cars, and his orders must be respected accordingly."

The following circular from the same company is dated Feb. 3:

"In addition to the duties of Depot-Master at Boston, Mr. A. A. Faunce, will hereafter perform those of a General Baggage Agent."

Flemington.—At the annual meeting in Trenton, N. J., Feb. 7, the following directors were chosen: Charles Bartles, Hugh B. Ely, Wm. P. Emery, T. B. Fidler, John C. Hopewell, John Riley, Ashbel Welch, Ashbel Welch, Jr., Alexander Wurts. The road is leased to the Pennsylvania Railroad Company.

Framingham & Lowell.—At the annual meeting at South Framingham, Mass., last week, the following directors were chosen: Samuel N. Aldrich, James W. Clark, Jacob Nichols, Edward Hastings, Samuel B. Rogers, J. R. Kendrick, D. E. Harding, John Fletcher, Jr., E. D. Hewins. The road is leased to the Old Colony Company.

Genesee Valley.—Mr. R. Bell has been appointed Chief Engineer, with office at Mt. Morris, N. Y. He has been for some years Assistant Engineer on the Erie.

Grand Trunk.—Mr. J. McGovern has been appointed Road-Master of the Central District, with headquarters at Brockville, Ont. Mr. McGovern was previously Track Supervisor at Goshen, N. H., on the Eastern District.

Havana, Rantoul & Eastern.—The following officers were recently chosen: President, B. J. Gifford; Vice-President, Solomon Wells; Secretary, Abram Crags; Treasurer and General Superintendent, H. G. Bullock.

Indiana, Bloomington & Western.—Mr. J. H. Wilson has been appointed Train-Master, a new office on this road.

Indianapolis & Eastern.—This new company has elected officers as follows: President, J. D. Campbell; Secretary, H. C. Diehl; Treasurer, C. W. Fairbanks. It is controlled by the Indiana, Bloomington & Western.

Indianapolis & Ohio State Line.—This company has elected the following officers: President, C. W. Fairbanks; Secretary, H. C. Diehl; Treasurer, C. E. Henderson. It is controlled by the Indiana, Bloomington & Western.

Laurens.—The purchasers of this road at foreclosure sale have organized a new company under the same name and elected directors as follows: John A. Barksdale, Laurens, S. C.; James Conner, A. C. Haskell, R. L. McCaughrin, Columbia, S. C.; T. M. Logan, Richmond, Va. The board elected R. L. McCaughrin, President.

London & Port Stanley.—This company has elected officers as follows: President, James Egan, London, Ont.; Vice-President, D. Van Buskirk, St. Thomas, Ont. The road is leased to the Great Western.

Louisville, Cincinnati & Lexington.—Mr. Brent Arnold has been appointed General Agent for this line at Cincinnati, O., to date from Jan. 28.

Mexican National.—Mr. J. C. Munro has been appointed General Master Mechanic and will have his headquarters at the city of Mexico. Mr. Munro was formerly Master Mechanic of the St. Paul, Minneapolis & Manitoba, but for some months past has been Division Master Mechanic of the Kansas City and St. Louis divisions of the Chicago & Alton road.

New Jersey Commissioner of Railroad Taxation.—The Governor of New Jersey has reappointed Major James S. Yard, of Freehold, State Commissioner of Railroad Taxation. Major Yard has held the office ever since it was first established.

New Orleans & Selma.—The officers of this road now are: John Tucker, Trustee in possession; L. B. Schofield, Superintendent.

Northern Pacific.—The following circular from the General Manager's office is dated Feb. 1:

"It having been considered expedient to separate the general freight and passenger departments of this company, Mr. J. M. Hannaford has received the appointment of General Freight Agent, and will hereafter conduct the duties of that department, with headquarters in this city [St. Paul, Minn.].

"Mr. Geo. K. Barnes is appointed General Passenger and Ticket agent, also with headquarters at St. Paul.

"Mr. Barnes, in addition to the duties of General Passenger and Ticket Agent, will have charge of all advertising connected with his department, and all outside passenger and traveling agents in the employ of this company."

Mr. Hannaford has been Chief Clerk in the general freight office for some time. Mr. Barnes was formerly on the West Wisconsin road and has been on the Chicago & Northwestern for some time past.

Pennsylvania Company.—Mr. George Driggs, Assistant General Counsel of the Pennsylvania Company and the Pittsburgh, Cincinnati & St. Louis Railway Company, at Pittsburgh, has been transferred to Chicago, to be Solicitor for the two companies at that point in connection with Mr. George Willard, of Chicago. Mr. Judson J. Brooks, of Cleveland, will take Mr. Driggs' place as Assistant General Counsel at Pittsburgh. Mr. Brooks is a brother of the General Counsel of these companies.

Pennsylvania Leased Lines.—Meetings of the following railroad and coal companies controlled by the Pennsylvania Railroad Company were held in Philadelphia, Feb. 8, and officers chosen as below: *Summit Branch.*—President, George B. Roberts; Vice-President, I. J. Wistar; Managers, A. J. Cassatt, J. N. DuBarry, John P. Green, James W. Johnson, Strickland Kneass, Wistar Morris, N. Parker Shortridge, Edmund Smith, Edwin P. Wooster. *Lykens Valley.*—President, George B. Roberts; Vice-President, I. J. Wistar; managers, A. J. Cassatt, J. N. DuBarry, John P. Green, Strickland Kneass, Wistar Morris, N. Parker Shortridge, Edmund Smith. *Mineral Railroad & Mining Co.*—The same as for the Lykens Valley Company. *Susquehanna Coal Co.*—The same as for the Lykens Valley Company.

Pittsburgh, Cincinnati & St Louis.—The following circular from General Manager D. W. Caldwell, is dated Feb. 1: "Mr. C. C. Waite is appointed Superintendent of the Little Miami Division, succeeding Mr. J. D. Ellison, resigned."

Mr. Waite is a son of Chief Justice Waite, of the United States Supreme Court, and a graduate of Rensselaer Polytechnic Institute at Troy, of the class of 1864; also a member of the American Society of Civil Engineers. For some ten years past he has been Superintendent of the Cincinnati & Muskingum Valley Division of this road, and his promotion to a more important division is a recognition of his energy and ability in his former position. Mr. Ellison, whom he succeeds, goes to the Kentucky Central as General Manager.

Mr. Ralph Peters has been appointed Superintendent of the Third Division, Columbus, Chicago & Indiana Central road. He has been for some time Chief Clerk in the office of General Superintendent Felton at Pittsburgh.

Providence & Worcester.—At the annual meeting in Providence, Feb. 7, the following directors were chosen: Wm. S. Slater, George A. Leete, Moses B. I. Goddard, Amos B. Lockwood, Frederick Grinnell, Providence, R. I.; Gideon L. Spencer, Pawtucket, R. I.; Lyman A. Cook, Oscar J. Rathbun, Woonsocket, R. I.; Paul Whitin, John C. Whitin, Whitins, Mass.; Estus Lamb, Blackstone, Mass.; Joseph E. Davis, John Dean, Elijah B. Stoddard, Worcester, Mass.; David K. Phillips, Boston. There is no change from last year.

Rochester & Pittsburgh.—The officers of this company (successor to the Rochester & State Line) are as follows: President, Walston H. Brown; Secretary, Thomas F. Wentworth; Treasurer, Frederick A. Brown. The directors are: Sylvanus J. Macy, Rochester, N. Y.; Frederick A. Brown, Walston H. Brown, Adrian Iselin, Jr., August Kountze, E. H. R. Lyman, Wheeler H. Peckham, Nelson Robinson, Wm. M. Schaffner, Jacob H. Schiff, George F. Stone, Frederick D. Tappan, New York; C. R. Cummings, Chicago.

St. Louis, Iron Mountain & Southern.—The following circular from General Superintendent A. W. Soper is dated St. Louis, Feb. 1:

"Mr. J. W. Brown having resigned the superintendency of the Texas Division of the St. Louis, Iron Mountain & Southern Railway, Mr. A. E. Buchanan is hereby appointed Superintendent of the Arkansas and Texas divisions, with headquarters at Little Rock."

Schuylkill Navigation.—At the annual meeting in Philadelphia, Feb. 8, the following were chosen: President, Frederick Fraley; Managers, Charles Baber, George Brooke, John N. Hutchinson, Thomas R. Patton, Michael Ward, Charles W. Wharton; Secretary and Treasurer, Richard Wilkins. The property is leased to the Philadelphia & Reading Company.

Spring Hill & Parrsboro.—At the annual meeting in St. John, N. B., Feb. 1, the following directors were chosen: E. Fisher, George McKean, C. A. Macdonald, Wm. Magee, C. A. Stockton, John Taylor, H. B. White; auditors, John McMillan, George F. Smith. The board re-elected E. Fisher President.

Union Railroad, Transit & Stockyards Co. of Indianapolis.—At the annual meeting in Indianapolis, Feb. 1, the following directors were chosen: W. R. McKeen, Horace Scott, E. F. Claypool, John F. Miller, C. C. Gale, John Thomas, E. W. Minshall, M. A. Downing, W. P. Ijams. The directors elected the following officers: President, W. R. McKeen; Vice-President, Horace Scott; Secretary and Treasurer, E. F. Claypool; Auditor, W. P. Ijams; General Manager, M. A. Downing.

Valley, of Ohio.—Mr. James E. Turk has been appointed Chief Engineer, in place of Charles B. Child.

Western & Atlantic.—At the annual meeting in Atlanta, Ga., last week, the old officers were re-elected as follows: President, Hon. Joseph E. Brown; Vice-President, E. W. Cole; General Manager, Wm. McRae; Secretary and Treasurer, W. C. Morrill.

Western Union Telegraph.—At a meeting held in New York, Feb. 5, Jay Gould and Russell Sage were chosen directors in place of David Jones, deceased, and Chester W. Chapin, resigned. Subsequently Gen. T. T. Eckert was chosen director and Vice-President in place of H. McK. Twombly, resigned, and was afterwards made also General Manager of the consolidated company. Jay Gould was chosen a member of the Executive Committee in place of Twombly, resigned.

West Jersey.—At the annual meeting in Camden, Feb. 8, the following directors were chosen: Coleman F. Leaming, Cape May Court House, N. J.; John M. Moore, Clayton, N. J.; Charles E. Elmer, Salem, N. J.; Lewis Mulford, Millville, N. J.; Thomas Jones Yorke, Glassboro, N. J.; Thomas H. Dudley, Thomas H. Whitney, Camden, N. J.; J. N. DuBarry, Strickland Kneass, George B. Roberts, Edmund Smith, N. Parker Shortridge, George Wood, Philadelphia. The only new director is J. N. DuBarry, who succeeds Josiah Bacon, deceased. The road is controlled by the Pennsylvania Railroad Company.

PERSONAL.

—Mr. Wm. J. Nicolls has resigned his position as Chief Engineer of the Danville, Mocksville & Southwestern road.

—Mr. I. H. Burgoon has resigned his position as General Superintendent of the Toledo, Delphos & Burlington road.

—Mr. John Houston, of Paterson, N. J., formerly Assistant Engineer on the Erie, has gone to Venezuela, where he will be employed in surveying railroad lines for the government of that country.

—Commander William H. Shock, the able Chief of the Bureau of Steam Engineering in the Navy Department, has been renominated for the same position, and will, no doubt, be confirmed, as it is understood that the Naval Committee will favorably report his nomination to the Senate.

—Mr. W. G. Oakman, for some years past Superintendent of the Utica Division of the Delaware, Lackawanna & Western road, has resigned that position and intends going into business in New York for the sale of railroad equipment and supplies on commission. Mr. Oakman is still a young man, but has made many friends and is recognized as a man of much ability and energy.

—Mr. Conrad N. Jordan, now Treasurer of the New York, Ontario & Western Company, has, in order to devote his whole time to the duties of that office, resigned his position as Cashier of the Third National Bank in New York, which he has held ever since the organization of the bank. Mr. Jordan is generally believed to be the agent and representative of Hon. Samuel J. Tilden in railroad matters.

—Hon. Andrew K. Hay, a prominent citizen of South Jersey, died at his residence in Winslow, N. J., Feb. 7, aged 72 years. He was an extensive manufacturer of glass, and also a large land-owner and a farmer on a considerable scale. He was long an active politician; was elected to Congress as a Whig in 1848, and was a Republican Presidential Elector in 1872. For many years he was a director of the Camden & Atlantic Company, and was chosen its President in 1873, holding the office until 1876, when he resigned on account of his increasing age and infirmities.

—Mr. Josiah Bacon, a well-known business man, and the senior director in length of service of the Pennsylvania Railroad Company, died at his residence in Philadelphia, Feb. 3, aged 68 years. He was born in New Jersey and came to Philadelphia in 1823, entering the service of R. D. Wood & Co., and he remained continuously with the same firm under its various changes of name, as clerk and afterwards as partner until his death. He was one of the largest stockholders of the Pennsylvania, and it is said that he never sold a share, having in his possession when he died the stock which he first bought, besides many shares since purchased. He was also a director in many of the company's leased and controlled lines. He was all his life a member of the Society of Friends, and was prominent in several of the charitable associations of Philadelphia.

TRAFFIC AND EARNINGS.

Southwestern Railway Association.

The Chicago *Tribune* says: "Although no meeting of the Southwestern Railway Association has been held for many months, yet its affairs are running along more smoothly than ever, and the equalization is made very promptly and balances settled at the end of every month. Settlements have already been made up to and including Dec. 31, 1880. The last statement shows that out of a total business of more than $2,800,000 by the three St. Louis lines, one line came within $800 of its allotted percentage, and the other of $400, while the third line was $1,200 ahead. A closer equalization could not well be made, and the difference amounts to less than half a day's business."

Immigrant Rates.

The war in immigrant rates at New York continues. In addition to previous reductions, the Pennsylvania Railroad announces that "20 per cent. deduction (from present tariff rates) will be allowed to immigrants purchasing tickets in the Garden, to meet the commissions paid outside, to points west of Pittsburgh, east of the Missouri River, south of St. Paul, and north of the Ohio River, and to points beyond these

places 20 per cent. of the proportion up to the limits named."

The Western lines, it is understood, will insist upon their refusal to pro-rate on the reduced fares, and will demand their share of the old tariff rates.

Railroad Earnings.

Earnings for various periods are reported as follows:

	1880.	1879.		Inc. or Dec.	P. c.
Year ending Dec. 31:					
At., Miss. & Ohio.	$2,064,194	$1,749,616	I.	$314,578	18 0
Chi. & West Mich.	840,022	654,384	I.	185,638	28.5
Detroit & Bay City	610,000	474,000	I.	136,000	28.7
Kan. City, Ft. Scott & Gulf	1,212,363	895,862	I.	316,501	35.2
N. Y., Lake Erie & West	19,489,365	16,509,119	I.	2,980,246	18.1
Net earn.	7,554,788	4,947,716	I.	2,607,072	52.7
Oregon Ry. & Navigation	3,252,525	2,297,819	I.	954,706	41.5
Net earnings.	1,795,064	1,161,921	I.	633,143	54.6
St. Paul & Duluth	596,113	.....		.....	.....
Wis. Central	1,064,046	762,500	I.	301,546	39.5
Month of December:					
At., Miss. & Ohio.	$181,746	$203,329	D.	$21,583	10.6
Chi. & West Mich.	79,146	58,767	I.	20,379	34.5
Kan. City, Ft. Scott & Gulf	132,979	94,682	I.	38,297	40.2
N. Y., Lake Erie & West	1,726,788	1,398,245	I.	328,543	23 5
Net earn.	497,183	349,768	I.	147,415	40.1
N. Y. & New England	198,108	.....		.....	.....
Net earnings.	26,409	.....		.....	.....
St. Paul & Duluth	45,706	.....		.....	.....
Wis. Central	28,718	17,729	I.	10,989	62.1
Month of January:	1881.	1880.			
Bur., Cedar Rap. & No.	$167,750	$184,317	D.	$16,567	9 0
Central Pacific	1,498,000	1,200,614	I.	297,386	24.8
Chi. & Alton	487,890	524,055	D.	36,165	6.9
Chi. & East. Ill.	125,455	72,466	I.	52,989	73.6
Chi., Mil. & St. Paul	991,700	764,298	I.	226,702	29.7
Chi. & N. W.	1,222,250	1,154,632	I.	67,618	5.9
Chi., St. Paul, Minn. & O., East Div.	128,555	105,405	I.	23,150	30.9
St. P. & S. C. Div.	111,731	88,422	I.	23,309	26.5
Cin., Ind., St. L. & Chi	171,466	155,697	I.	15,769	10.1
Cin. & Springfield	74,533	69,899	I	4,634	6.6
Cleve., Col., Cin. & Ind.	299,903	312,603	D.	12,700	4.1
E. Tenn., Va. & Ga.	108,517	111,065	D.	2,548	2.3
Flint & Pere Mar.	135,378	109,992	I.	25,386	23.1
Grand Trunk	759,528	730,066	I.	29,462	4.0
Great Western	359,478	351,244	I.	8,234	2.3
Han. & St. Jo.	153,067	176,079	D.	23,012	13.1
Houston & Tex. Cent.	359,706	319,041	I.	40,665	12.7
Ind., Bloom., & West	89,485	79,673	I.	9,812	12.2
Int. & Gt. No	181,463	159,543	I.	21,920	13 7
Louisville & Nash	808,010	674,455	I.	133,555	19.8
Mem. & Charleston	111,842	129,265	D.	17,423	13.5
Mobile & Ohio	218,243	250,116	D.	31,873	6.7
Peoria, Dec. & Evansville	40,607	14,211	I.	26,396	188.4
St. L., A. & T. H., Main Line	101,774	96,922	I.	4,852	5.0
Belleville Line	67,684	56,217	I.	11,467	20.4
St. L., Iron Mt. & So.	559,400	555,983	I.	3,417	0.6
St. L. & San Fran.	212,435	195,695	I.	16,740	8.5
St. P., Minn. & Man.	254,187	180,239	I.	73,948	41.1
Wabash, St. L. & P.	811,617	928,603	D.	116,986	12.6
Third week in January:					
Minn. & St. L.	$12,596	$8,458	I.	$4,138	48.7
Week ending Jan. 28:					
Great Western	$86,660	$79,459	I.	$7,201	9.0
Week ending Jan. 29:					
Grand Trunk	$189,114	$200,027	D.	$10,913	5.4

Grain Movement.

For the week ending Jan. 29 receipts and shipments of grain of all kinds at the eight reporting Northwestern markets and receipts at the seven Atlantic ports have been, in bushels, for the past eight years:

Year.	Northwestern receipts.	Northwestern shipments.	Atlantic receipts.
1874	2,408,458	1,073,518	2,111,715
1875	1,681,032	1,023,004	1,740,379
1876	2,109,285	1,041,550	1,969,365
1877	1,868,739	839,521	2,022,351
1878	2,520,392	2,272,058	3,798,653
1879	3,597,455	1,350,918	3,384,156
1880	3,652,141	1,571,904	2,371,989
1881	3,287,602	1,656,550	2,682,456

Compared with the corresponding weeks of previous years, thus, the receipts of the Northwestern markets are the smallest for three years, but their shipments the largest for three years; while the Atlantic receipts are larger than last year, but much smaller than in 1879 or 1878.

Compared with previous weeks, the Northwestern receipts are the largest for five weeks, the Northwestern shipments a little larger than the week before but with that exception the smallest for four weeks, and the Atlantic receipts the largest for five weeks.

Of the Northwestern receipts Chicago had 45.1 per cent., St. Louis 14.7, Toledo 11.3, Milwaukee 10.8, Peoria 10.5, Detroit 4.1, and Cleveland 3.5 per cent.

Of the Atlantic receipts New York had 32.1, Baltimore 20.9, New Orleans 17.3, Boston 15.8, Philadelphia 12.4, Portland 1, and Montreal 0.5 per cent. New York's proportion is unusually small.

For the four weeks ending Jan. 29, the grain and flour movement has been for four years (flour in barrels and grain in bushels):

	1881.	1880.	1879.	1878.
Northwestern receipts:				
Flour	822,495	495,900	533,936	559,105
Grain	14,728,027	17,674,948	16,127,677	13,732,424
Northwestern shipments:				
Flour	864,854	529,090	552,995	523,517
Grain	8,829,359	6,326,713	6,539,070	8,755,323
Atlantic receipts:				
Flour	1,218,003	957,295	702,665	817,490
Grain	11,636,489	14,138,527	12,617,048	16,018,993

Taking grain alone, the Northwestern receipts are the lightest for three years, the Northwestern shipments the largest recorded in a January, and the Atlantic receipts the smallest for four years. But the flour movement has changed so greatly that this modifies the position. Reducing flour to wheat at the rate of a barrel to five bushels, the Northwestern receipts were about 7 per cent. less than last year, the Northwestern shipments 39 per cent. more, and the Atlantic receipts 6⅛ per cent. less.

Exports from Atlantic ports for five successive weeks have been:

	Feb. 2.	Jan. 26.	Jan. 19.	Jan. 12.	Jan. 5.
Flour, bbls.	123,920	147,994	131,278	189,310	120,499
Grain, bus.	2,029,828	2,101,331	1,623,952	1,800,826	2,206,164

For the five weeks ending Feb. 4 receipts of flour and grain at four Eastern ports were:

	1881.	1880.	Inc. or Dec.	P. c.
Flour:				
New York	593,232	408,236	I. 184,996	45.3
Boston	178,247	144,786	I. 43,461	32.3
Philadelphia	98,435	53,540	I. 44,895	83.9
Baltimore	86,580	55,518	I. 31,062	57.7
Total	956,494	652,080	I. 304,414	46.7
Grain:				
New York	3,017,439	4,395,008	D. 477,569	10.8
Boston	1,719,154	1,469,030	I. 250,124	17.0
Philadelphia	1,420,725	1,562,200	D. 141,475	9.1
Baltimore	2,023,722	2,235,449	D. 211,727	9.7
Total	9,081,040	9,661,687	D. 580,647	6.0

In these totals the increase in flour is a little more in weight and more than twice as much in equivalent bread stuffs as the decrease in grain.

Southern Railway & Steamship Association.

The following circular from General Commissioner Powers is dated Feb. 1:

"At the last session of the Rate Committee, held at Savannah, Ga., Jan. 12 to 14, 1881, the following resolution, in reference to rebilled freight, was adopted:

"*Resolved*, That rebilling be continued, but with such restrictions and under such rules (to be made by the General Commissioner) as the General Commissioner of the Southern Railway & Steamship Association may deem necessary to prevent the system being used to cut rates or otherwise worked improperly, and that the General Commissioner be, and he is hereby, authorized to employ any force necessary to insure enforcement of the rules made by him, said force to be paid by the lines practicing rebilling. In case the General Commissioner finds any road or line abusing the privilege of rebilling, he is authorized to stop the same by such action of connecting roads as he may direct. Rebilling is not to be done by Western lines to Eastern lines' territory east of the Savannah River (except to Points on Atlanta & Charlotte Air Line Railway south of Cowpens station, and to Charleston, Port Royal, Savaunah, Brunswick and coast points south thereof), and rebilling is not to be done by Eastern lines to Western lines territory west and south of the line named above.

"The following resolution was also adopted at the same session:

"*Resolved*, That all rebilled freight way-bills south of rebilling point must show delivering line, original point of shipment, date of expense bill and number of car north of rebilling point. No expense bills shall be used for rebilling of older date than below:

"Wheat and product, July next preceding date of shipment.

"Oats and hay, September next preceding date of shipment.

"Corn and hog product, November next preceding date of shipment."

The circular adds the rules prepared to enforce these regulations in detail.

Packing and Provisions.

For the three months (nearly) of the packing season from Nov. 1 to Jan. 26, the number of hogs packed in the Northwest has been:

1880-81.	1879-80.	1878-79.
6,304,909	5,618,541	6,425,546

The number packed this year is thus 12.2 per cent. more than last year, but nearly 2 per cent. less than in 1878-79. Of the whole number, Chicago packed 37.2 per cent. this year, against 32.8 per cent. last, and 38 per cent. in 1878-79.

The number packed at each of the leading centres has been as follows in the last two years:

	1880-81.	1879-80.	Inc. or Dec.	P. c.
Chicago	2,350,000	1,845,000	Inc. 505,000	27.4
Cincinnati	505,000	490,000	Inc. 15,000	3.0
St. Louis	450,000	535,000	Dec. 85,000	15.9
Indianapolis	353,000	312,000	Inc. 41,000	13.1
Milwaukee	275,000	285,000	Dec. 10,000	3.5
Louisville	215,670	230,000	Dec. 14,330	6.2
Kansas City	255,000	153,700	Inc. 101,300	66.0

Shipments of hog products from Chicago for the three months ending Jan. 29 were:

	1880-81.	1879-80.	Increase.	P. c.
Pounds	415,972,719	285,510,578	130,462,141	45.7

Exports from the United States for the same period were:

	1880-81.	1879-80.	Increase.	P. c.
Pounds	361,997,971	297,009,808	64,988,163	21.9

This year the Chicago shipments have been much greater than the exports; last year they were a little less.

Coal Movement.

Anthracite tonnages for the month ending Jan. 29 are reported as follows, the tonnage in each case being only that originating on the line to which it is credited:

	1881.	1880.	Inc. or Dec.	P. c.
Phila. & Reading	360,306	405,046	D. 44,740	11.0
Northern Central, Shamokin Div. and Summit Br. R. R.	66,893	41,303	I. 25,590	62.4
Sunbury, Hazleton & Wilbesbarre	.....	1,146	D. 1,146	100 0
Central of N. J., Lehigh Div.	184,302	293,312	D. 109,010	37.6
Lehigh Valley	329,629	311,607	I. 18,022	5.7
Pennsylvania & N. Y.	2,675	1,215	I. 1,460	120 2
Del., Lacka. & Western	247,716	278,904	D. 31,888	10.5
Del. & Hudson Canal Co.	198,572	303,811	D. 105,239	34.6
Pennsylvania Coal Co	67,945	43,280	I. 24,665	57.4
State Line & Sullivan	4,514	3,023	I. 1,491	49 7
Total anthracite	1,462,552	1,682,647	D. 220,095	13.1

The tonnage of anthracite for the corresponding period for six years has been:

1881	1,462,552	1878	1,211,022
1880	1,682,647	1877	1,193,933
1879	1,440,200	1876	1,245,232

Anthracite trade is a little unsettled, and the basis of working for next month is unknown, on account of the refusal of some of the companies to agree upon any stoppage or short time arrangement. Shipments from the mines have, in some cases, been interrupted by snow blockades, and there has been a temporary scarcity of some sizes—especially stove and nut—at tide-water. This, however, will soon be remedied.

Actual tonnage of anthracite passing over the Pennsylvania & New York road for the two months of its fiscal year from Dec. 1 to Jan. 30 was: 1881, 111,170; 1880, 108,568; increase, 2,602 tons, or 2.4 per cent.

The shipments from the Sewanee mines in Tennessee over the Nashville, Chattanooga & St. Louis road in January were: Coal, 475,524 bushels; coke, 279,510 bushels; total, 755,034 bushels; increase over January, 1880, 215,313 bushels, or 40 per cent. The shipments exceeded those of any previous month by 89,375 bushels.

The returns from the coal mines of the province of Nova Scotia for 1880 show the total output for the year to have been 1,033,710 tons. Shipments from the mines were 954,659 tons, an increase of 266,035 tons, or 38.6 per cent., over the previous year.

Semi-bituminous tonnages reported for the month were as follows:

	1881.	1880.	Inc. or Dec.	P. c.
Cumberland	99,287	143,485	D. 44,198	30.9
Huntingdon & Broad Top	17,943	19,432	D. 1,489	7.7
East Broad Top	5,186	3,999	I. 1,187	29.7
Tyrone & Clearfield	130,745	198,548	D. 67,803	34.1
Bellefonte & Snow Shoe	2,961	6,197	D. 3,236	52.2
Total semi-bituminous	256,122	371,661	D. 115,539	31.1

Actual tonnage passing over the Huntingdon & Broad Top road for the month was:

	1881.	1880.	Inc. or Dec.	P. c.
Broad Top coal	17,943	19,432	D. 1,489	7.7
Cumberland coal	17,945	12,413	I. 5,532	44.6
Total	35,888	31,845	I. 4,043	12.6

Shipments of Cumberland coal away from the region for the month were as follows:

	1881.	1880.	Inc. or Dec.	P. c.
Baltimore & Ohio R. R.	79,382	129,391	D. 50,009	39.9
Bedford Div., Pa. R. R.	14,136	11,127	I. 3,009	27.1
Ches. & Ohio Canal	.....	2,583	D. 2,583	100.0
Total	93,518	143,101	D. 49,583	34.7

The full statement of Cumberland shipments for the year 1880 is as follows:

	Tons.
Baltimore & Ohio R. R.	1,244,155
Bedford Div., Pennsylvania R. R.	213,460
Chesapeake & Ohio Canal	603,125
Local use	75,420
Total	2,136,160

Of this total 1,740,737 tons passed over the Cumberland & Pennsylvania road; 328,850 tons over the Cumberland Branch, and 66,573 tons were from West Virginia mines on the Baltimore & Ohio road.

Bituminous tonnages reported for the month are:

	1881.	1880.	Inc. or Dec.	P. c.
Barclay R. R. & Coal Co.	35,207	38,907	D. 3,700	9.5
Allegheny Region, Pa. R. R.	18,688	23,119	D. 4,431	14.9
Penn. & Westmoreland	69,488	75,361	D. 5,877	7.8
West Penn. R. R.	28,883	13,011	I. 15,872	122.1
Sou hwest Penn. R. R.	3,593	5,716	D. 2,123	37.3
Pittsburgh Region, Pa. R. R.	52,171	33,505	I. 18,666	55.7
Total bituminous	208,026	189,619	I. 18,407	9.7

Bituminous tonnages show a considerable decrease for the month on some lines, partly due to difficulty in moving trains and getting cars.

Coke tonnages reported for the month are as follows:

	1881.	1880.	Inc. or Dec.	P. c.
Bellefonte & Snow Shoe	805	.....	I. 805	.....
Allegheny Region, Pa. R. R.	7,536	5,011	I. 2,525	50.5
Penn. & Westmoreland	13,075	9,321	I. 3,754	40.3
West Penn. R. R.	6,559	7,324	D. 765	1.1
Southwest Penn. R. R	127,314	58,260	I. 69,064	119.0
Pittsburgh Region, Pa. R. R.	39,565	60,244	D. 20,679	34.4
Total coke	194,854	140,160	I. 54,694	39.1

The increase in coke is apparently to be continuous this year as last.

THE SCRAP HEAP.

Locomotive Building.

It is reported that contracts have been let for 50 new locomotives for the Missouri, Kansas & Texas extension lines in Texas.

The Schenectady Locomotive Works, in Schenectady, N. Y., have received some additional large orders for locomotives for the New York Central and Lake Shore roads.

The Danforth Locomotive Works, in Paterson, N. J., hav a number of orders for locomotives on hand.

It is reported that plans have been prepared and a large amount subscribed for new locomotive works in St. Louis to have a capacity of at least 200 engines a year.

Car Notes.

Porter & Meakin, of the Atlanta Machine Works in Atlanta, Ga., have recently extended their foundry and built a new erecting shop for cars. They have recently built 25 freight cars, and have rebuilt or repaired several sleeping and passenger cars.

The Louisville & Nashville shops in Mobile, Ala., have lately built 40 new flat cars, besides doing the usual repair work.

Mr. James G. Wilson, of New York, patentee and agent of the rolling Venetian blinds and flexible car blinds, has orders for his rolling Venetian blinds for the large fleet of excursion boats now building for the Iron Steamboat Company, of New York, to run to Coney Island and Rockaway. These boats are to be very handsomely fitted up.

It is reported that 20 passenger, 6 baggage and 3,000 freight cars have been ordered for the Missouri, Kansas & Texas extensions in Texas.

The Jackson & Sharp Co., at Wilmington, Del., is building several refrigerator milk cars for the Warwick Valley road

The Huntingdon Car Works, at Huntingdon, Pa., are building 650 freight cars for the Texas & Pacific road.

Articles of incorporation have been filed in Ohio by the Lima Car Works. The shops are to be in Lima, O., and the capital stock is fixed at $100,000.

Bridge Notes.

The Philadelphia Bridge Works of Cofrode & Saylor, at Pottstown, Pa., have recently taken contracts for an iron bridge of three spans, 150 ft. each, for the Texas & Pacific; also for six spans of 100 ft. each and a draw-span of 200 ft. for the New Orleans Pacific.

The Northern Pacific bridge over the Missouri at Bismarck, Dak., designed by Mr. George S. Morison, Engineer, will have three spans of 400 ft. each, and two of 125 ft. each. The superstructure will contain about 500 tons of steel and 1,000 tons of iron; it will be built by the Detroit Bridge & Iron Works. The contract for the foundations and masonry of the piers and abutments has been let to Saulspaugh & Co., of Rock Island, Ill.

Iron and Manufacturing Notes.

Moser & Thompson, at Cleveland, O., have lately furnished an iron roof for the depot at White River Junction, on the Vermont Central road, besides a number of other buildings.

Work is now well advanced on the new works of the North Chicago Steel Co., at South Chicago. The blowing engines are now being put in place.

The Joliet Iron & Steel Co., at Joliet, Ill., is running its rolling mill steadily on steel rails.

Some very large sales of rail-fastenings are said to have

been made in St. Louis last week, chiefly for new lines in Texas.

The Rail Market.

The market for steel rails is unsettled, with an upward tendency. About $60 per ton at mill is the ruling price, but some small sales are reported up to $62.50.

Iron rails are active and are quoted from $47 per ton at mill for 56 lbs. and over, up to $51 for light rails. A sale of English rails at $45 per ton at tidewater is reported. Prospects are good, especially for light rails.

Old iron rails are steady, with light sales and holders generally firm. Asking prices are $28.50 to $31 per ton in Philadelphia. In the same city there is some inquiry for old steel rails, and about $30 per ton has been offered.

British Rail Exports.

For the year 1880 the exports of rails from Great Britain, according to the report of the Board of Trade, were as follows, in tons:

	1880.	1879.	Increase.	P. c.
Steel	464,401	332,145	132,256	39.8
Iron	139,689	55,071	84,618	153.6
Total	604,090	387,216	216,874	56.0

The changes in the *average value* per ton of the exports are shown below:

	1880.	1879.	Increase.	P. c.
Steel	$34.08	$28.57	$5.51	19.6
Iron	31.65	25.94	5.71	22.0

The exports to the United States for the twelve months were:

	1880.	1879.	Increase.	P. c.
Steel	120,655	23,681	96,974	409.6
Iron	97,863	20,955	76,908	319.5
Total	218,518	44,636	173,882	389.6

Thus of the total exports from Great Britain 36.2 per cent. went to the United States in 1880, against only 11.5 per cent. in 1879. Of the *increase* of British rail exports more than nine-tenths of the iron and nearly three-fourths of the iron were due to the United States.

Prices of Scrap.

An active demand for scrap is reported at Pittsburgh, and quotations are about as follows: Car-springs, $44 per ton; car-axles (steel), $41; No. 1 wrought scrap, $30; boiler plate, $32 to $34; wrought turnings, $20 to $22; old car-wheels, $33 to 35, long ton; cast scrap, $19 to $20.

Probably an Imposter.

A man giving his name as Charles R. Moriand, "Chief Engineer E., F. & A. R. R.," has been arrested at McKenzie, Tenn., for obtaining money under false pretences. He had in his possession passes over a large number of Southern and a few Northern roads. He had been very liberal with promises of positions on his road in various capacities at unusually liberal salaries.

"E., F. & A." does not stand for any railroad that we have any knowledge of; perhaps some of our readers may know of it.

A Car Turns a Somersault.

Yesterday the "Louisiana" mail coach was again put upon the Atlanta & West Point track, and, in charge of Route Agent Jackson, went through to Montgomery. This is the first trip for the coach since the accident near Opelika, some three weeks ago, in which it was demolished. When the accident occurred, the mail coach became uncoupled from the tender and the baggage car, and jumping over the telegraph wire landed on the ground several feet from the track. This somersault is vouched for by Mr. Harris, the route agent, who was in the car, and the railroad men in charge of the train. No one saw the coach make the wonderful leap, but as it landed on the other side of the telegraph wire, and the bell-cord was over the wire, a dozen men will swear the coach made the wonderful leap.—*Atlanta (Ga.) Constitution, Feb.* 1.

A Lost Truck.

Friday morning conductor W. L. Baxter and baggage-master George Baker were "yarning it," when the former related two singular occurrences on the Erie, which the latter at once corroborated.

Six or eight years ago conductor William Somers was running a train of empty coal cars from Newburg to Port Jervis. The train arrived in Port Jervis toward morning, and when it got here the startling discovery was made that one of the coal dumps had lost a pair of trucks—that is, the framework that holds the two axles and four wheels on one end of the car. When or where the trucks had been detached was not known, but it was surmised that it was west of Middletown. Train 12, due in Port Jervis at about four a. m., had left here, and could not be warned to look out for the "breakers" until it reached Middletown. There was "hurrying to and fro" then, for it was almost certain that the trucks must have "scooted" over upon the eastward track, because it had not interfered with the rest of the train. If 12 struck the trucks there might be a wreck. Middletown was promptly notified, and orders sent for 12 and all other trains to look out for the stragglers.

Train 12 that morning was so big that two engines were used over the eastern division. The train was scooting along just west of Howells, when the glare of the headlight and the dim light of morning disclosed something on the track only a short distance ahead. The head engine struck this something, and a great wreck was narrowly escaped. When the train was stopped it was discovered that the obstruction was a pair of trucks, which had been standing square upon the track. The trucks were wrecked and so was the head engine, but no lives were lost.

When the train arrived at Middletown the mystery as to how those trucks got on the track was learned. It seemed they had become detached from the coal dump, had been forced off the track and across to the other track on which they had landed squarely, each wheel in its place on the rail. The coupling had held the end of the car up, so that the accident was not known until discovered in the Port Jervis yard.—*Port Jervis (N. Y.) Gazette.*

New Palace Cars for the Quebec, Montreal, Ottawa, & Occidental Railway.

Two new palace sleeping cars have recently been completed for this line, in the shops of the road, under the supervision of Mr. Dain, the Mechanical Superintendent. The names of the cars are the Chapleau and Robitaille. The following particulars are extracted from a description of them published in the Montreal *Gazette*:

The cars are 75 ft. long or 60 ft. in the clear, and are carried on two six-wheeled trucks. The cars are intended to serve as palace or drawing-room cars in the day-time and as sleeping-cars at night. The day cars contain 28 "reclining, revolving and rocking chairs, covered with red silk plush." The floor is covered with Brussels carpet. The beds are wholly out of sight in the day-time, and are concealed by black mahogany panels supported by massive hinges and decocrated with flowers, baskets of fruit, etc., carved out of Italian satin-wood, turquoise, emerald, rose and other woods.

At the end of the car is a state-room and in the next compartment a double lavatory with plate-glass mirrors. The mattresses are supported by patent wire spring beds. The windows are three times larger than in ordinary cars. The ventilation of the cars has received special care.

The Westinghouse Brake in France.

In a recent report to the Paris, Lyons & Mediterranean Railway, M. E. Marié, Ingénieur-en-Chef du Matériel et de la Traction, recommended the adoption of the Westinghouse brake on all the passenger rolling stock and engines of this great system, and of its immediate application to fast trains and those used for suburban traffic. In concluding his report, M. Marié says: "I have the honor to propose to the directors of the Paris, Lyons & Mediterranean Railway: 1. To approve of the three contracts proposed between the railway on one side and Mr. Henry and the Westinghouse Company on the other. 2. To adopt in principle the application of the Westinghouse brake for all passenger rolling stock. 3. To authorize its actual and immediate application to all through, express, and suburban trains. 4. To furnish me with a credit of 2,300,000 francs for this limited application." The whole equipment will refer to 800 engines and 5,447 cars, and a first contract has been signed with the Westinghouse Company for fitting up 300 engines and 1,210 carriages, the cost of which will be about £88,000. The expense of applying the brake to the whole system will be upward of £320,000.—*Engineering.*

Boilers of Steam Vessels—Rules Adopted by the Board of Supervising Inspectors.

Captain B. S. Osbon, in behalf of the Steamboat Association of New York, recently appeared before the Board of Supervising Inspectors of Steamboats in Washington, in reference to amending rule 10 of the regulations of the Boar d. The Board amended the rule in question so that it now stands that all externally fired boilers on steamboats on inland waters shall have a space between them and the surrounding woodwork of not less than four inches above the top of the boiler and six inches on the sides, and all internally fired boilers on steamers navigating oceans, sounds, bays, lakes, etc., shall have a space between the woodwork and boiler of not less than two inches on top and four inches on the sides and not less than two feet in the wake of the door of the back connections. This new rule will, it is understood, give universal satisfaction to steamboat men in all sections of the country. During the amending of the rule a dispatch was received urging this action, signed by all the leading steam vessel owners of the Pacific Coast.

Union Electric Railroad Signals.

The Cincinnati Southern Company are about to put the Union electric signal in a number of tunnels, and the Nashville, Chattanooga & St. Louis Company have put it in their tunnel in Nashville. This signal is also being put on the Little Miami and the Pittsburgh, Cincinnati & St. Louis. The Pittsburgh, Ft. Wayne & Chicago have put this company's block and signal in their Allegheny City yards. Fourteen miles of the Chicago & Western Indiana are being equipped. The Chicago, Milwaukee & St. Paul are putting in the interlocking signal. The Fitchburg is putting in the signal from Belmont to Waltham.—*Journal of the Telegraph.*

Gas for Light-Houses.

The Railway Marine Gas Works, of which Mr. J. M. Foster is Chief Engineer, has recently constructed 10 beacons for Currituck and Albemarle sounds, in North Carolina, which are to be lighted with gas. These beacons will burn for 75 days. An automatic apparatus which is operated by clockwork is used, which turns the gas off and on and lights it morning and evening. It is proposed to light all the screw-pile light-houses in Chesapeake Bay by the same system.

A Torpedo Accident.

It is the rule at Clyde for all west-bound freight trains that want water, to stop east of the Glasgow street crossing while the engine goes up to the water tank. Last Thursday forenoon such a train stopped just below the freight house. As the engine was backing up after taking water, one of the brakemen named George Orr, belonging in Syracuse, stood ready to couple the engine and first freight car. In the left-hand-side pocket of Orr's overcoat were four railroad torpedoes. Just as the cars came together the wind blew that part of the overcoat, in which was the pocket containing the torpedoes, directly between the bumpers and the four torpedoes were exploded with a report that was heard in the centre of the village. Mr. Orr's coat and pantaloons were blown into rags, and his left leg, between the knee and hip, was terribly burnt and lacerated. The unfortunate man was taken to the office of J. E. Smith, where the wound was properly dressed, after which he returned to his home in Syracuse by the noon train.—*Rochester Democrat and Chronicle, Jan.* 28.

Fast Time Thirty Years Ago.

A correspondent writes to the Utica (N. Y.) *Herald* as follows: "The *blasé* youth who sits at his midnight card-table and breathes an Alexandrine sigh for 'more worlds!' believes that he lives in a fast age, and that he himself is one of its fastest atoms. Even the man in middle life is prone to look upon the present as an advance upon the past, and his view is undoubtedly correct, in the main, though there appears to be a curious exception. In the last quarter of a century it would seem as if the capacity of the steam engine had remained at a standstill. I speak from no practical knowledge of the steam engine, but merely from its power as shown in the locomotive and the steamboat. Many times during the past few years I have stated to friends that about 1853 or 1854, I traveled from New York to Utica in six hours and 45 minutes. My statement has invariable been contradicted. One of the last persons to whom I made this assertion—a lady, and fairly accurate considering her sex—received my remarks with an unbelief that almost staggered me. She had journeyed many times between New York and Utica, and she knew very well that before "the special" was put on, the trip was never made in less than 10 or 11 hours. I suggested that she used to take a slow train, but was informed that of course she took the fastest train at the time. Finally, I determined to consult my usually reliable friend, William Dunn. And this was our conversation at the station: 'How long have you been here, William?' 'Thirty-seven years and over.' 'Do you remember a train that reached Utica at 1:10 p. m.—one that came up from New York in less than seven hours?' 'No, sir! Why the time from Albany here, before 'the special' was put on, was five hours.' 'William, have you any money in your pocket?' 'I never bet!'—(virtuously.) Then William escorted me up stairs, and I was kindly allowed to rummage among old time-tables to my heart's content. At the end of an hour I told William that in 1855, the regular time between Utica and Albany was three hours. And he replied: 'That would be a good thing to catch the boys on, for the cigars!' How a single hour may change our ideas! But the most satisfactory results were obtained from an examination of the files of the Utica *Morning Herald* for 1852–53. At this time there was a lively competition between the Hudson River road and the Harlem. The former advertised quick transit from Albany to New York, and fare $1.50. The latter supplemented the seductive fare of only $1 by the following: 'Passengers by taking this delightful route will avoid the dangers and disasters incident to a road running on the margin of a deep river, and at the same time receive gentlemanly attention, etc.' In June, 1853, after the consolidation of the roads making up the New York Central, a time-table went into operation showing faster time than has ever been made since. The New York express left Albany at 10:30 a. m. and arrived in Utica at 1:10 p. m.—two hours and 40 minutes! The train making connection with this at Albany left the Thirty-first street station in New York at 6:25 a. m., thus achieving the distance from New York to Utica in six hours and 45 minutes—and this including the transfer of baggage and passengers, by ferry boat, at Albany. What is the fastest time to-day, with a bridge at Albany? Seven hours and 10 minutes! At that period, trains ran from New York to Albany (East Albany, of course), in three hours and 45 minutes. The fastest train to-day consumes over four hours. And they used to make up time in those days, too. Read this from the Utica *Morning Herald* of May 16, 1853: 'Quick time. The locomotive "Quickstep" brought the express train from Syracuse to this city, on Friday, in one hour and 15 minutes, including four stops—making the running time less than an hour.' Those were great days for the boys of Utica, when each engine had a personality—a name—instead of an uninteresting number. I have forgotten most of the names, but I think I remember 'Diomede,' 'Atlanta,' 'Quickstep,' 'Lightning,' 'Erastus Corning,' 'C. C. Vibbard.' I had a boy friend at that time, who could distinguish each passenger locomotive by the sound of its whistle, or its bell.

"Nor were the steamboats on the Hudson behind the age in speed; as it is recorded in the Utica *Herald* that on July 1, 1853, the steamer Alida ran from New York to West Point, 52 miles, in two hours and 10 minutes."

Fractures of Steel Rails.

In a recent issue of the *Organ für die Fortschritte des Eisenbahnwesens*, Herr Theune states the results of his observations with respect to the fractures of steel rails in the district (Kattowitz) under his observation. He notes that 329 such fractures took place during the years in which his interesting observations were made. Among the rails which were laid in the open country, there were 2.4 fractures per mile, while in forests, where rails are exposed to greater damp, the rate rose to 6.7 per mile. The changes of the various seasons have a striking influence on the number of breakages which take place. Thus, during the first quarter of the year (the coldest season generally) there were 216, in the second quarter 28, in the third quarter 14, and during the fourth quarter 71 fractures. The greatest number of fractures of rails took place from the eigth to the tenth years after their having been laid down; the average working time was found to be 7.5 years. With respect to the parts where fractures took place, Herr Theune remarks that there were 73 fractures in the face of the rail, 51 breakages in the web, and as many as 265 fractures through the fish-plate holes.

Westinghouse vs. Eames.

Under this title the Eames' Vacuum Brake Co., of Watertown, N. Y., has published a little pamphlet with regard to the legislation between it and the Westinghouse Air Brake Co., especially with regard to the statement by the latter that it withdrew its suit against the Eames Company, in order, after reissuing one of its patents, to enter a new suit in a form which would materially strengthen its case. The pamphlet says that the Eames Company relied for its defence on its claim that a patent granted to Henry W. Adams in 1871 for a vacuum engine, and now owned by the Westinghouse Company, was really the invention of an Englishman, and described by him in a patent granted in 1833. The new suit brought by the Westinghouse Company, the pamphlet says, does not include the original Westinghouse patent of 1869, nor the Adams, but is brought for infringement of the reissued patent, which is for an improvement of the apparatus patented by Westinghouse in 1869.

Styles in Railroad Passenger Cars.

There is as much change in the style of railroad passenger cars as in house architecture or ladies' bonnets, and constant improvement in the fashion and quality of the work is insisted upon by the managers of roads. At present the change of taste seems to be in the direction of inside finish. In the best passenger cars now made the old-fashioned elliptic window heads are replaced by a square finish—lighter woods, like cherry and silver gray, being substituted for black walnut, which is regarded as too heavy, and the old gilt moldings are done away with, the natural grain of the wood being the only ornament. The baskets above are also made square, the metal being as nearly as possible of the same color as the wood finish around them. These improvements do away with the showy appearance of the interior of the old cars, but give an exceedingly rich and elegant effect. The head linings of canvas are also being to a great extent replaced by wood.—*Hartford (Conn.) Evening Post.*

OLD AND NEW ROADS.

Atlanta & West Point.—This company has offered to build a branch from its road at Whitfield, Ga., south by east to Greenville, in Merriwether County, a distance of 13 miles, provided the people on the line will raise enough to pay for the grading and ties.

Atlantic, Mississippi & Ohio.—Application was made this week to the United States Circuit Court to postpone the foreclosure sale and to appoint a master to take account of the liens and claims against the road, in order that the company might have an opportunity to redeem the road by paying off the debts. After hearing argument, however, the Court refused the application, and ordered the sale to be made on Feb. 10, as heretofore directed.

It is understood that Gen. Mahone, President of the company, had made arrangements with New York parties to advance the money to redeem the road if the Court allowed it. Who they are does not very clearly appear, but Jay Gould is said to have had a hand in the matter. The motion to postpone the sale was opposed by the consolidated bondholders and the Clyde syndicate.

The Virginia Board of Public Works has agreed to sell the state's interest in the road—nominally $4,000,000—to parties representing Wm. P. Clyde and others, the so-called Clyde syndicate, for $500,000, of which the sum of $100,000 was paid down.

Baltimore & Ohio.—The amendments to the Delaware Western charter, under which this company expected to pass through Delaawre with its proposed line to Philadelphia, rather hang back in the Delaware Legislature, having met with unexpected opposition.

Bay City & Alpena.—This is the second company formed to build a railroad from Alpena, Mich., southward along the shore of Lake Huron to Bay City. This organization is apparently in the interest of the Detroit & Bay City Company. An effort to consolidate the two rival companies is to be made.

Boston, Barre & Gardner.—This company reports that for the last fiscal year, ending Sept. 30, 1880, there was a surplus over all expenses, interest and rentals, of $4,823.56, against a deficit the previous year of $6,723.79. The increased receipts come principally from through freight, and this indicates that a still further increase of through business can be done by the road for a much less outlay than income. With reference to the recent bond-scaling agreement, holders of $64,000 of the first mortgage, who refused to accept 5 per cent interest instead of 7 per cent. have a suit at law, which the directors are confident will be thrown out of court, when by paying them some $5,000 for back interest all difficulties under this head will cease.

Boston & Charles River.—A preliminary organization has been made of this company, which is to build an entrance into Boston for the projected Mystic Valley road.

Canada Southern.—The Buffalo *Commercial Advertiser* says: "It is expected that the new bridge across Niagara River at Tonawanda, for the Canada Southern Railroad, will be commenced in the spring. The reasons for building this structure are that the International Bridge is inadequate to accommodate all the traffic moving over it, the yards at Black Rock are too small, and the tolls charged by the International Bridge Company are excessive. When the bridge is completed there will be a double track road from Buffalo to Tonawanda and the freight yards will be established at the latter place."

Cedar Rapids, Oskaloosa & Southwestern.—This company has been organized to build a railroad from Cedar Rapids, Ia., southwest to Albany, Mo., about 190 miles. The company promises to begin work at once on the 75 miles from Cedar Rapids to Oskaloosa.

Central, of South Carolina.—Books of subscription to the stock of this company have recently been opened. The proposed line is from Sumterville, S. C., on the Wilmington, Columbia & Augusta road, south by east to Manning, and thence to a connection with the Northeastern road, a distance of about 45 miles. With existing roads it would complete a new line between Columbia and Charleston.

Chesapeake & Ohio.—Contracts for the building of the extension from Richmond, Va., eastward to Newport News, at the mouth of the James River, have been let to Mason, Shanahan & Hoge, of Staunton, Va., and McMahon & Green, of Lynchburg. The distance is 66 miles, and the work is to be done by July next.

It is said that work is to be pushed on the western connection along the south bank of the Ohio from Ashland, Ky., to Newport, opposite Cincinnati, about 140 miles. The right of way has been secured from Ashland nearly to Maysville.

Chicago & Alton.—Contracts have been let for a new line from Godfrey, Ill., by Milton to Upper Alton, a distance of seven miles. This loop will avoid two heavy grades, and will be used chiefly for freight trains.

Chicago & Iowa.—Recently the Appellate Court at Ottawa, Ill., granted an order directing the Receiver to turn over this road to the directors known as the Aurora board. A few days later, however, the Illinois Supreme Court granted a *supersedeas* setting aside this order, on the ground that the Appellate Court had exceeded its jurisdiction in making the order. This latest action keeps the road in the hands of the Receiver.

Chicago, Milwaukee & St. Paul.—A new grain elevator with a capacity of 1,000,000 bushels is to be built for this company on the North Branch of the Chicago River in Chicago. It is intended for the business coming in over the Chicago & Pacific Division.

Chicago & Northwestern.—It is said that the gauge of the Galena & Wisconsin line will be changed from 3 feet to standard gauge as soon as the weather will permit; also that a line will be built from Galena to a connection with the Clinton line.

The extension of the Chicago & Dakota Division has been located from the Missouri at Ft. Pierre, Dak., westward about 50 miles. The line is by way of Bad River and the North Fork of the Cheyenne.

It is said that contracts have been made for about 500 miles of new road to be completed during the year 1881, amongst which are a cut-off line from Milwaukee to Madison, about 80 miles; a branch from Madison to Montfort, 60 miles, connecting the Chicago & Tomah narrow-gauge, purchased last year, with the main line, and forming a through route from Milwaukee to Woodman and Galena; a branch from Henson, Dak., up the valley of the James River, the probable length being about 80 miles; a branch from the main line of the Dakota Division up the valley of the Sioux River; an extension of the Toledo & Northwestern, in Iowa, from Webster City to the Minnesota line, 80 miles, and a branch of the same road from Callahan to Lake City.

Cincinnati & Southeastern.—An effort is being made to raise money for the construction of this road from Covington, Ky., southeast to West Liberty, in Morgan County, a distance of 135 miles. The road was formerly known as the Covington, Flemingsburg & Pound Gap, and is now completed from Johnson Junction to Hillsboro, 18 miles.

Cincinnati Terminal Facilities.—A dispatch from Cincinnati, Feb. 8, says: "The Chamber of Commerce today adopted the report of the Committee on Terminal Facilities, which recommended the appointment of a permanent committee on the subject, and suggested the necessity of the abandonment of the canal within the city limits, and the substitution of a railroad therefor. The committee visited Indianapolis and Chicago to gather information, and reported that Chicago transferred freight at one-fifth the cost required for similar service in Cincinnati and with great saving of time."

Columbus, Chicago & Indiana Central.—In the suit of this company against the Pittsburgh, Cincinnati & St. Louis and the Pennsylvania railroad companies, the United States Circuit Court has made an order allowing the sum of $285,125 for counsel fees and legal expenses. Of this sum $190,000 are divided among counsel in the case, 15 in number; the trustees, Roosevelt and Fosdick, receive $62,261, and the sum of $25,000 is given to the bondholders' committee.

Columbus & Rome.—An effort is being made to secure the extension of this road from its present terminus at Hood, Ga., north by west to La Grange, on the Atlanta & West Point road. The distance is 17 miles, and the estimated cost is not over $90,000.

Elizabeth City & Norfolk.—Tracklaying commenced on the Norfolk end of this road Jan. 31, and will be pushed as fast as possible. Tracklaying from Elizabeth City, N. C., was to be begun this week. The engines, passenger and freight cars are at Portsmouth, Va., waiting the opening of the road, which, the company hopes, will take place some time in March next.

Georgia Railroad Commission.—A dispatch from Augusta, Ga., Feb. 9, says: "In the United States Circuit Court in the case of George H. Tilley against the Railroad Commissioners of Georgia, and the Savannah, Florida & Western Railroad Company, Justice Woods has just rendered his opinion, refusing the injunction prayed for, dissolving the restraining order temporarily granted, and sustaining the Railroad Commission. The decision will put into operation on the Savannah, Florida & Western the rates prescribed by the commission."

Greenville, Columbus & Birmingham.—Proposals will be received by H. T. Irish, Secretary of this company, at Greenville, Miss., until March 21 for building 20 miles of this road from Stoneville, Miss., to the Sunflower River. Bids may be made for the whole work, or separately for the grading, bridges, tracklaying and ties, the company to furnish the iron in either case.

Hannibal & St. Joseph.—Notice is given that 25 land grant bonds have been drawn for redemption under the terms of the mortgage. They will be paid on presentation to the Farmers' Loan & Trust Company in New York. The numbers drawn are 24, 77, 88, 122, 160, 186, 193, 200, 246, 283, 290, 358, 399, 410, 453, 490, 500, 654, 677, 686, 693, 705, 755, 839 and 843. Interest on these bonds will cease April 4.

Hartford & Connecticut Valley.—The Connecticut Railroad Commission last week gave a hearing to the application of this company for an extension from Hartford, Conn., north to Holyoke, Mass. The company also has a bill before the Massachusetts Legislature to authorize the building of the extension in that state. The proposed line is on the west side of the Connecticut River, running parallel to the New York, New Haven & Hartford road from Hartford to Windsor Locks, and thence through Poquonnock, Windsor, Rainbow and Old Suffield to West Springfield, connecting there with the Boston & Albany, and then due north to Holyoke. The extension is opposed by the existing lines.

Jeffersonville, Madison & Indianapolis.—It is said that the Pennsylvania Company purposes building a branch from this road at Greenfield, Ind., east by south a point on the Little Miami road a few miles out of Cincinnati. The new road would be about 95 miles long, and would make a pretty direct line between Cincinnati and Indianapolis.

Kansas City & Bates County.—This company has filed articles of incorporation in Missouri to build a railroad from Freeman, in Cass County, south to Rich Hill in Bates county, 35 miles. The capital stock is fixed at $350,000. The corporators are Joel H. Nash, Austin, Mo.; A. C. Turner, Westport, Mo.; James S. Bottsford, M. T. C. Williams, Kansas City, Mo., and Joseph E. Young, of Chicago.

Kansas City, Burlington & Santa Fe.—It is announced that this road has been bought by parties in the interest of the Atchinson, Topeka & Santa Fe. The new owners have settled the suit in which a receiver was recently appointed, and have taken possession of the road. It extends from Burlington, Kan., southwest to Ottawa, 46 miles, and will be worked hereafter as a branch of the Kansas City, Lawrence & Southern Kansas road.

Lake Park & Crookston Air Line.—This company has been incorporated in Minnesota, the capital stock being fixed at $2,000,000. The proposed line starts at Lake Park on the Northern Pacific, runs thence northwest by way of Crookston to a point on the Red River below Grand Forks, with a branch line up the right bank of the Red Lake River to the Thief River; the headquarters of the company to be at Crookston.

Laurens.—The purchasers of this road at foreclosure sale have organized the Laurens Railway Company, and have received a deed of the property from the Court. The road extends from Newberry, S. C., to Laurens, 31 miles, and it will be worked as a branch of the Columbia & Greenville road.

Marietta & Cincinnati.—Receiver King reports for December total receipts of $277,524; disbursements, $290,917, leaving a debit balance of $13,393 to January.

Minnesota State Railroad Bonds.—A dispatch from St. Paul, Minn., Feb. 8, says: "At a meeting of the Committee of Twenty appointed by the Legislature to consider the claims against the state on account of the old Minnesota railroad bonds, it was resolved to accept the proposition of Mr. Selah Chamberlain, of Cleveland, and incorporate in its bill to be reported all claims of like character, including the railroads constructing. Every member of the committee but one solitary granger voted in the affirmative on the proposition. Mr. Chamberlin's proposition is to submit the legal question to the Supreme Court, and in the event of the liability of the state being affirmed, to accept 50 per cent. of the claim in the form of a new 6 per cent. 30-year bond, a sinking fund to be created to meet the principal at maturity. It is believed that the action of the committee will meet with the approval of the Legislature, and that the long-pending matter may in this way be compromised."

Missouri Pacific.—It is said that the loop line from Kansas City to Lexington, formerly the Kansas City & Eastern road, is to be abandoned and the rails taken up. The people at some of the stations on the line make strong objections.

Muncy Creek.—This road has been placed in hands of a receiver on application of some of the creditors. The road is only seven miles long, from Catawissa Junction to Hughesville, Pa.; it has a bonded debt of $180,000, on which over two years interest is due.

New York Central & Hudson River.—About 9 o'clock on the morning of Feb. 8, the arched roof of the older part of the passenger depot on Exchange street in Buffalo fell, dragging down the outer wall with it. A yard engine and two or three cars were crushed, and all that portion of the building completely wrecked. Fortunately very few people were in it at the time, and only four bodies have been found up to this writing, though several narrow escapes are reported. The fall is variously attributed to the great weight of snow on the roof, to the breaking of a rod in one of the roof trusses, and to the weakening of a supporting wall by the openings cut through into the new part of the building.

The New York Supreme Court at General Term has decided that this company's road from the Grand Central Depot in New York to the Harlem River, known as the Fourth avenue Improvement, is not taxable. The Court holds that as the railroad company had a franchise to run its trains upon the level of Fourth avenue, it has not benefited in that respect by the act of 1872, authorizing the construction of the improved cut, and that the public was benefited in being relieved of the danger resulting from the passage of locomotives and trains on the surface of Fourth avenue. The Court holds also that the fact that the railroad company defrayed part of the cost of the improvement does not make it the owner of the work; that the city is the owner, and that the railroad company is the possessor simply of the easement and exclusive privilege of using the cut for the passage of its trains. The conclusion from all this is, therefore, says the Court, that the walls, substructures, superstructures, bridges, etc., of the improvement are not assessable as real estate and taxable on the railroad company, and that the taxation must be limited to the tracks of the company in the improvement, as real estate, under the recent decision of the Court of Appeals. The matter is therefore remanded to the tax commissioners, and they are directed to proceed anew with the assessment and taxation.

New York, Chicago & St. Louis.—This company has been incorporated in Indiana, and will be also in Ohio and Illinois. The incorporators are: C. R. Cummings, George I. Seney, J. T. Martin, E. H. R. Lyman, A. M. White and Walston H. Brown. It is proposed to build a line from Cleveland to Chicago, a distance of 340 miles, or 15 miles shorter than the route by the Lake Shore & Michigan Southern. It is also intended to extend a line from Fort Wayne Junction, about 25 miles west of Fort Wayne, to St. Louis, a distance of 325 miles. The company has purchased 56 miles of the Wabash Canal, which gives it right of way in Fort Wayne. The contract for building the new road has been given to Brown, Howard & Co., of Chicago. The line from Cleveland to Chicago, it is said, is to be completed this year, and that to St. Louis by July, 1882. The capital stock of the company is $16,000,000, of which $13,000,000 have been taken by a syndicate which has deposited 10 per cent. in cash on the subscription, with the Metropolitan National Bank. Regarding the extension of the new road eastward, nothing has been decided upon. The capitalists interested in this new project are prominently identified with the Lake Erie & Western, and the Ohio Central and the Peoria, Decatur & Evansville companies.

New York, Ontario & Western.—Work is now in progress on the extension of this road from Middletown, N. Y., to Cornwall and thence to Haverstraw, and on the tunnel through which the tracks are to reach the Hudson River at Weehawken. On this extension from Middletown to Weehawken there are three tunnels, the first at West Point being 2,640 feet long; it will probably be finished in September. The second tunnel, at Haverstraw, is 1,620 feet long, and will be done in about a year. The tunnel back of Weehawken, under Bergen Hill, will be 4,225 ft. long. All these tunnels are to be built for double track, and will be 27 ft. wide and 21 feet high, with semi-elliptical roof, 27 ft. diameter and 9 ft. rise. It will take over a year to open the extension, as its completion must depend upon the tunnels.

The arrangements for building the New York, West Shore & Buffalo road in connection with this road are noted elsewhere.

New York, West Shore & Buffalo.—It is announced that a contract to build this road has been taken by the North River Construction Company, an organization chiefly composed of stockholders of the New York, Ontario & Western Company. This road will start from Cornwall, N. Y., and run up the west shore of the Hudson to Athens, there leaving the river and running west by north to Oneida and thence west to Buffalo. It is claimed that the line from New York to Buffalo will be only about 410 miles long, with no grade over 30 ft. to the mile. From Cornwall to Jersey City the track of the New York, Ontario & Western road is to be used.

The North River Construction Company, which has been organized some time, purposes increasing its capital stock from $500,000 to $10,000,000. Owing to the mutual interests of the West Shore and the Ontario & Western companies, preference in the matter of subscriptions to the new stock of the Construction Company is to be given to the stockholders of record on Feb. 15, of the New York, Ontario & Western Company. The right to subscribe at par is offered to the extent of one share of construction stock for every 40 shares of the Ontario & Western stock. The first installment of 20 per cent. is to be paid by Feb. 19, further installments of not more than 10 per cent. in any two months to be paid as called, upon not less than 10 days' notice. No voting power is to attach to the increased construction stock until it is fully paid up, the scrip issued for the installments as paid being placed in trust with the Central Trust Company. When the stock is fully paid up it is to stand in the names of three trustees, who are to have the power to vote upon the shares during the years. The holders of scrip are to receive all dividends which may be declared. Gen. E. F. Winslow is the President of the North River Construction Company.

North Carolina Midland.—It is given out that as soon as the reorganization of the Virginia Midland is completed, work will be begun on this road, which is to extend the Midland from Danville to Charlotte. The road has been surveyed from Danville to Mooresville, and some promises of local aid secured. From Mooresville to Charlotte it is proposed to use the Atlantic, Tennessee & Ohio road, provided satisfactory arrangements can be made, but as an alternative a line is now being surveyed from Mooresville south to a point on the Atlanta & Charlotte Air Line, about 10 miles west of Charlotte.

Northern Pacific.—This road during the last four months of the year delivered at Duluth 2,513,000 bushels of wheat, and at Minneapolis 280,000 bushels, and of this about four-fifths were of the quality known as "No. 1 hard," which commands about 10 cents a bushel more than the best winter wheat, which goes a good way towards paying the freight.

The work of construction for 1881 is laid out on a large scale, and the capital being secured the company will be able to push it vigorously. Even this winter work is progressing in rock excavations on the Yellowstone Division (which begins where the Missouri Division strikes the Yellowstone, not far beyond the present end of the track, 187 miles from the Missouri River), and this will be built as fast as possible. Some grubbing has been done, too, on the Wisconsin Division, from Duluth eastward, which is to extend to the Montreal River at the boundary between Wisconsin and the Upper Peninsula of Michigan. On the western end of the road, the Pend d'Oreille Division has the grading completed for about 125 miles beyond (northwest) of the present end of the track (45 miles north of Ainsworth and 57 from Wallula), which leaves but a few miles of this division to be graded. The next division west, leading from Ainsworth to Puget Sound, is the Cascade Division, which has been thoroughly surveyed so as to permit a final location, and contracts for getting out ties and timber (timber abounds on this division), were to be let Feb. 1. On the Rocky Mountain Division surveys are progressing. Though the great effort of the company is to push forward its main line as fast as possible, the company this year will begin a system of branches in Dakota. The Casselton Branch, now extending from Casselton (25 miles west of Red River) north 31 miles to Blanchard, will be extended northwestward, with the design of reaching ultimately the Canadian border; another line will be built from Jamestown northwest, and a third from the Red River at Fargo southwest and west. Heretofore, while the company was expending all its energies on its main line, other corporations, like the St. Paul, Minneapolis & Manitoba and the Chicago, Milwaukee & St. Paul, seemed likely to occupy the fine wheat producing valleys of Dakota on both sides of the Northern Pacific, but the con

struction of these branches will secure it feeders, which may be of great importance to it.

Pennsylvania.—Surveys have been completed for the proposed extension of the Tyrone & Clearfield Branch from Curwensville, Pa., to Cherry Tree, about 38 miles. Two lines have been surveyed from Curwensville to Belleville, and it is not decided yet which will be used. From Belleville to Cherry Tree there is only one line, which follows the West Branch of the Susquehanna.

Argument was heard some time ago in the United States Circuit Court on behalf of the Western Union Telegraph Company, praying for a preliminary injunction to restrain this company from interfering with its telegraphic facilities on the New York Division. The Court still holds this matter under advisement. Feb. 8 the Pennsylvania Railroad filed an application for a counter-injunction to restrain the Western Union Telegraph Company from using the rights and privileges granted by the Pennsylvania Railroad Company to the American Union Telegraph Company. The Court, pending the hearing of the case, which will probably be Feb. 11, ordered that "the Western Union Telegraph Company be restrained from using the telegraph poles and wires of the American Union Telegraph Company in such manner as to violate the rights of the Pennsylvania Railroad Company under the agreement of Jan. 17, 1880, with the American Union Telegraph Company."

It is said that negotiations for a settlement of the trouble are in progress.

Philadelphia & Reading.—Argument has been in progress before the United States Circuit Court in Philadelphia this week on the application to restrain the managers from issuing the deferred income bonds, or bonds under the proposed new general mortgages. No decision has been reached.

The floating debt of the company is now stated at $23,570,813, which is made up of $5,142,529 deferred coupon scrip; $2,454,000 income bonds; $2,500,000 due various sinking funds; $730,752 unpaid coupons; $10,464,046 accounts and balances due and $2,279,486 receivers' certificates.

Philadelphia, Wilmington & Baltimore.—This company, having removed its freight and transfer yards from their old place in Wilmington, Del., will shortly use the room thus gained for extending its shops. The new buildings will be a carpenter shop 40 by 130 ft., two stories; a planing mill 40 by 95 ft., two stories, the second to be used as a cabinet shop; a paint shop 20 by 60 ft., and a lumber shed 40 by 200 ft. Work has been begun on the new buildings.

Richmond & Allegheny.—Track laying from Richmond, Va., westward on this road has now reached New Canton, 70 miles from Richmond and 11 miles beyond the point where the track ended at the close of the year. The survey of the North River Branch is nearly completed to Lexington.

Rochester & State Line.—The purchasing bondholders have completed the organization of the Rochester & Pittsburgh Company, and have filed the necessary articles of incorporation.

In the matter of the distribution of the proceeds of the foreclosure sale, the Court has granted an order directing the referee to ascertain the present owners of certain detached coupons from the bonds and their title to a share in the proceeds. In relation to these coupons the Referee makes the following statement to the Rochester *Democrat and Chronicle*:

"It appears that the holders of the bonds and coupons mentioned in the decree and upon which the decree was based, are entitled to 25.11682 cents on each dollar of the bonds and coupons of which they are owners. I have received $2,112,800 in these bonds. This leaves $47,200 in bonds outstanding which are not in the syndicate. Those represented by the first of these amounts are the assenting bondholders, while those represented by the latter amount do not assent to the sale and reorganization of the road. Of all the bonds now in my possession not one has all the original coupons attached, but they all have the coupons from Jan. 1, 1881."

Roswell.—The people on the line having subscribed enough to pay for the grading and ties, the Atlanta & Charlotte Air Line has agreed to lay the track and work this road. It is to leave the Air Line at a point 13 miles out of Atlanta and run north to Roswell, about 10 miles. The road will be of 3 ft. gauge.

St. Johnsbury & Lake Champlain.—This company—the old Portland & Ogdensburg, Vermont Division—has decided to make an issue of $600,000 mortgage bonds, to be used to build an extension from Swanton, Vt., around the north end of Lake Champlain to Rouse's Point, N. Y., to connect with the Ogdensburg & Lake Champlain. The road is, at present, without any outlet or connection at its western end.

St. Louis, Alton & Terre Haute.—This company has made arrangements to settle the arrears of dividends on its preferred stock, which now amount to 58 per cent. A cash dividend of 3 per cent. has been declared, and for the remaining 55 per cent. the holders are to have new 6 per cent. income bonds. This arrangement will be carried out as soon as a meeting of the common stockholders can be held.

St. Louis, Keokuk & Northwestern.—This company has begun the work of laying a new track between Keokuk, Ia., and Buena Vista, a distance of three miles.

St. Louis & New Orleans Barge Line.—The St. Louis & New Orleans Transportation Company, which went into operation on May 1 last, has rendered a statement to the stockholders from which we extract the following:

Gross earnings for eight months	$244,885.70
Operating expenses, same period	190,941.44
Net earnings, Dec. 31, 1880	$53,944.26

"The tonnage employed has consisted of 5 steamers and 32 barges. Eighteen of the latter have been built by the company since August last. Besides these vessels, new contracts have been let for the construction of one first-class steamer and 15 additional grain barges of the largest size and best description, all of which have been commenced, and some of them are very nearly ready for use. This addition to our tonnage, with other vessels which it will be necessary to build in the near future, will largely increase our capacity for business, and in some measure meet the urgent pressure which has constantly been made upon our carrying capacity since the formation of the company.

"In the month of November the initial steps were taken for the erection of a grain elevator at Belmont, Mo., and the work is now being prosecuted at that point. The present cold season and low stage of water has fully demonstrated the wisdom and necessity of the undertaking, and the benefits sure be derived therefrom will be very large."

Sanpete Valley.—The grading of this road is about all done and some of the iron received, but no track has been laid as yet. The distance from Salt Lake City to Nephi, Utah, the junction of the Sanpete Valley Road with the Utah Southern, is 91 miles. The gauge is to be 3 feet 6 inches.

Savannah Valley.—A contract has been let for the grading of the first section of this road, extending from Anderson, S. C., southward 20 miles. The grading of the 20 miles, most of which is light work, was taken for $12,850 in all.

Scioto Valley.—A dispatch from Ironton, O., says that the first train for Portsmouth over the extension of this road ran through on Feb. 7. Regular trains will run hereafter. The distance from Portsmouth down the Ohio to Ironton is about 28 miles.

Securities on the New York Stock Exchange.—The following securities have been placed on the lists at the New York Stock Exchange:

Chicago, Milwaukee & St. Paul.—Chicago & Pacific 6 per cent. bonds, $1,000,000, numbered 2,001 to 3,000; Hastings & Dakota Division 7 per cent. bonds, $450,000.

St. Louis, Jacksonville & Chicago.—First-mortgage bonds, guaranteed, $564,000; second-mortgage bonds, guaranteed, $188,000; second-mortgage bonds, $360,000; preferred stock, $1,034,000; common stock, $1,293,000. Road leased by Chicago & Alton.

Wabash, St. Louis & Pacific.—General mortgage 6 per cent. bonds, $6,000,000.

Sierra Iron Co.—The Sierra Iron Company has filed a declaration of intention to build a railroad of 2 ft. gauge from Oroville, Cal., along the Feather River through American, Mohawk and Sierra valleys and Beckwith Pass to the state line, thence to connect with a railroad now being constructed from Reno, and following a route in the direction of Beckwith Pass, Long and Honey Lake valleys to the state of Oregon. The declaration also includes the privilege to construct a branch line from the middle fork of the Feather River, near Eagle Creek, by Jamieson Creek to the Sierra iron mines, and thence to Downieville, about 24 miles, and of another branch from Oroville to the Sacramento River, via Chico, about 28 miles. The capital stock is $1,200,000, of which amount $250,000 has been subscribed, and assessments paid exceeding $30,000.

South Bend Southern.—This company has been organized to build a railroad from South Bend, Ind., south to Plymouth, on the Pittsburgh, Ft. Wayne & Chicago, about 20 miles. The plan also includes an extension from Plymouth south to Logansport, about 45 miles.

Tehuantepec.—This company contradicts a statement that work on the road has been suspended. Work from the Gulf end of the road is being pushed as fast as possible. Mr. Wm. J. McAlpine, Consulting Engineer, left San Francisco Feb. 7 with a party of assistants to begin work on the Pacific end of the line.

Telegraph Consolidation.—On Feb. 3, Judge Barrett, of the New York Supreme Court, rendered a decision refusing to grant an injunction in the suit of Rufus Hatch to prevent a consolidation of the companies. Judge Barrett referred to the law of 1870, which is as follows:

"In order to perfect and extend the connection of telegraph companies in this state, and promote their union with the telegraph systems of other states, any telegraph company organized under the laws of this state may lease, sell or convey its property, right, privileges or franchises, or any interest therein, or any part thereof, to any telegraph company organized under or created by the laws of this or any other state; and may acquire, by lease, purchase or conveyance, the property, rights, privileges and franchises, or any interest or any part thereof, of any telegraph company organized under or created by the laws of this or of any other state, and may make payments therefor in its own stock, money or property, or receive payments therefor in the stock, money or property of the corporation to which the same may be sold, leased or conveyed; provided, however, that no such purchase, sale, lease or conveyance by any corporation of this state shall be valid until it shall have been ratified and approved by a three-fifths vote of the board of directors or trustees, and also by the consent thereto in writing or by vote, at a general meeting duly called for the purpose, of three-fifths in interest of the stockholders in such company present or represented by proxy at such meeting.

After the decision of Judge Barrett was known, the following was furnished Thursday evening by W. B. Somerville, Superintendent of the Press Bureau of the Western Union Telegraph Company:

"Meetings of the stockholders of the Western Union Telegraph Company, American Union Telegraph Company and Atlantic & Pacific Telegraph Company were held in this city to-day, and the agreement entered into by the directors of the said companies, on Jan. 19, 1881, for a consolidation of the companies, was ratified, and the Western Union Telegraph Company, through Mr. John Van Horne, Vice-President, took formal possession of the American Union and Atlantic & Pacific Telegraph companies this evening, the signs and blanks of the Western Union Telegraph Company being sustituted for those used heretofore by the two other companies."

The following notice appeared on Feb. 4:

"The Western Union Telegraph Company having this day completed the purchase and taken possession of the lines, properties, rights and privileges of the American Union Telegraph Company, David H. Bates has been duly appointed agent of this company and General Manager of the lines, offices and operations of the properties and rights turned over by the American Union Telegraph Company, and Albert B. Chandler has been duly appointed Agent of this company and General Manager of the properties and rights turned over by the Atlantic & Pacific Telegraph Company until further notice of a concentration of management.

"All officers and employés of either of said companies will be retained in the service of this company till further notice, and all business done and revenues accruing in the operation of said lines will be reported and turned over to this company."

The *Commercial and Financial Chronicle* says: "The law of 1870, quoted by Judge Barrett, seems to say decidedly that such a consolidation can only be legalized by a consent or vote of three-fifths of the stockholders '*at a general meeting duly called for the purpose.*' The punctuation in the law is somewhat important, but the natural construction would appear to be that the consent in writing should be given at a meeting duly called for the purpose."

Texarkana & Ft. Smith.—A company has been incorporated to build a railroad from Texarkana northward to Ft. Smith, passing through Miller, Little River, Sevier, Polk and Sebastian counties in Arkansas, all of these counties being on the western border of the state. The distance is about 150 miles, and the capital stock is fixed at $4,000,000. The incorporators are James Lanagin, Ft. Smith Ark.; J. Gilbreath, Waldron, Ark.; E. H. Jordan, Dallas, Ark.; H. M. Beidler and J. H. Draughon, Texarkana.

Tioga.—It is said that work will be begun early in the spring on an extension of this road from Arnot, Pa., southwest to Morris, about 12 miles. This extension will open up several new coal mines.

Troy & Greenfield.—A committee of the Massachusetts Legislature has been hearing certain complaints as to the management of this road. So far Manager Gardner seems to have vindicated himself in a very difficult position in the face of the opposition of the Fitchburg and the Troy & Boston companies—which are certain to be against any management which they cannot control.

Another committee of the Legislature has been giving a hearing to the application of the old Troy & Greenfield Company for leave to bring a suit against the state in the Supreme Court for the purpose of establishing its right to redeem the road under the contract by which it passed into the possession of the state originally.

Vermont & Canada.—The directors of this company met in Boston last week and passed the following resolution:

"*Whereas*, The Supreme Court of Vermont in 1877 made its decision (published in 50th Vermont Reports), therein holding or determining that the Vermont & Canada Railroad was not liable to be taken and sold to pay or satisfy debts incurred by so-called trustees and managers, and in December, 1880, made another decision upon the same state of facts as before, that the same railroad is liable to be taken and sold to satisfy such debts, and that the Court would order or decree such sale whenever duly called upon to do so; and,

"*Whereas*, These two conflicting decisions were made by the same bench of judges, with one exception, and we are not able to reconcile such vacillating and inconsistent action with an honest purpose of administering the law without fear or favor; therefore,

"*Resolved*, That, though under present circumstances we think it would be useless for us to pursue any legal remedies in behalf of the Vermont & Canada Railroad Company in the state court of Vermont, we yet deem it proper to recommend to stockholders not disposed to submit tamely either to a seeming hardship or a palpable wrong, that they seek redress in their own name and behalf in the courts of the United States, and there get the opportunity of contesting whatever title the state court, in the exercise of its power of confiscation, may hereafter attempt to confer on those persons who were by this same state court placed in charge of our railroad as stewards for our benefit and at our request."

Western & Atlantic.—The Atlanta *Constitution* of Feb. 6 says: "The lessees of the Western & Atlantic Railroad have just closed their annual meeting. Senator Brown, who has been here to attend the meeting as President of the lease company, leaves to-day for Washington. The meeting was harmonious. Only the original lessees were present. None of the new purchasers were on hand. A dividend was declared, and other arrangements made to carry on the company in terms of the lease act. We have noticed the fact that all the old officers are re-elected. The suit that was instituted by Mr. C. H. Phinizy and others against the lessees was dismissed formally on Friday, on motion of plaintiff's counsel. The suit has been virtually ended some time, but it had to be formally dismissed before the new parties could participate in the dividends. The road is in a very prosperous condition. The business over it is steadily increasing. If private parties owned the road a double track would be provided to carry the freight."

ANNUAL REPORTS.

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Missouri Pacific.

This company has published the following brief statement for the year 1880: At the close of the year the company owned the line from St. Louis to Atchison, 331 miles, with branches from Kirkwood to Carondelet, 12 miles; Sedalia to Lexington, 56 miles; Kansas City to Lexington, 44 miles; Pleasant Hill to Nevada, 69 miles; Paola, Kan., to Leroy and Ottawa, 79 miles. It leased the lines from Atchison to St. Joseph, 21 miles; Boonville by Tipton to Versailles, 44 miles, and Holden, Mo., to Paola, Kan., 54 miles. It worked the Central Branch, Union Pacific, from Atchison to Logan, 268 miles, with 94 miles of branches, making 592 miles owned, 119 leased and 362 worked, 1,073 miles in all.

The stock and debt are as follows:

Stock ($20,979 per mile owned)	$12,419,800
Bonds ($32,932 per mile)	19,496,000
Total ($53,911 per mile)	$31,915,800

The income statement for the year was as follows:

Gross earnings	$5,325,341.83
Expenses (53.50 per cent)	2,848,971.52
Net earnings	$2,476,370.31
Interest and rentals	1,320,300.00
Surplus	$1,156,070.31

Charges in mileage during the year have been such that no comparison can be made with the previous year.

The surplus as shown above was equal to about 9¼ per cent. on the stock. Two dividends, each of 1½ per cent., were declared and paid, one on Oct. 8, 1880, and one on Jan. 3, 1881. The company expects to keep these up regularly hereafter.

Prince Edward Island.

This road is owned by the Dominion of Canada, and is of 3 ft. 6 in. gauge. It extends the whole length of Prince Edward Island, having a line from Georgetown to Tiguish, 152.5 miles, a line from Mt. Stewart to Souris, 38 miles, and 8 miles of short branches, making 198.5 miles in all. The report of the Minister of Railways and Canals covers the year ending June 30, 1880.

Expenditures on capital account during the year were $16,539.82. The total cost of the road up to the close of the year was $3,466,588.57, or $17,464 per mile.

The earnings for the year were as follows:

	1879-80.	1878-79.	Decrease.	P.c.
Gross earnings	$113,851.11	$125,855.91	$12,004.80	9.5
Expenses	104,640.55	223,313.12	58,672.57	26.3
Deficit	$50,789.44	$97,457.21	$46,667.77	41.5
Gross earn. per mile	573.56	634.03	60.47	9.5
Per cent. of exps.	144.61	177.44	32.83	....

The deficit is met by the government. Passenger earnings decreased $6,787.92, while freight earnings fell off $3,216.48. The road serves a thinly peopled country with no large towns and no manufactures, and is likely to be always a burden on the government.